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14. ABSTRACT
This TOP provides guidance for preparing test plans and conducting test programs to evaluate the transportability characteristics of military equipment whether towed, self propelled, or moved by carrier over highway, off-road terrain, railway, waterway, or by air.

15. SUBJECT TERMS

Fixed wing	Sling attachments	Air dropped	Shelter
Rotary Wing	Tie-down attachments	Containers	Free-fall

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U.S. ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

*Test Operations Procedure (TOP) 1-2-500 15 September 2008
DTC AD No.:

TRANSPORTABILITY

*This TOP supersedes TOP 1-2-500, dated 7 February 1973.

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1. SCOPE.

This TOP provides guidance for preparing test plans and conducting test programs to evaluate the transportability characteristics of military equipment whether towed, self-propelled, or moved by carrier over highway, off-road terrain, railway, waterway, or by air. Transportability is an important factor in maintaining the "inventory in motion" concept of the modern, highly mobile army. Materiel must be able to survive transportation in a military environment without reduction in functional performance. The environment imposes numerous constraints involving impacts, vibrations, interferences, and repetitive motions requiring attention to blocking, bracing, slinging, tie-down, and containerization in connection with the stowage, orientation, suspension, or transfer of cargo. Adequacy of design depends upon compatibility with the transportation media and performance after handling and transport.

All tests specified herein are not applicable to all test items. The test planner will be selective to include only those tests needed to satisfy the requirements for the specific item to be tested. Data from previous and similar tests and data obtained by concurrent testing will be considered to avoid duplication and reduce the scope of testing.

The Army's Executive Agent (EA) for the Engineering for Transportability Program, the Director, Surface Deployment and Distribution Command Transportation Engineering Agency (SDDCTEA), will be consulted by all Army materiel developers for transportability guidance and approval of their equipment that meets the definition of a transportability problem item as outlined in DOD Directive 4540.07.[1**] Equipment and systems are considered a problem item when any of the following conditions apply:

a. Item is wheeled or tracked, and is to be towed, hauled, or self-propelled off highway or on highway.

b. Materiel exceeds any of the following conditions:

(1) Length - 6.1 m (20.0 ft).

** Superscript numbers/letters correspond to those in Appendix , References.

(2) Width - 2.4 m (8.0 ft).

(3) Height - 2.4 m (8.0 ft).

(4) Weight - 4,535 kg (10,000 lb).

(5) Weight per linear foot - 726 kg (1,600 lb).

(6) Floor contact pressure - 345 kPa (50 psi).

(7) Maximum axle load (pneumatic tires) - 2,268 kg (5,000 lb).

(8) Maximum wheel load (pneumatic tires) - 1,134 kg (2,500 lb)

(9) Tire pressure - 621 kPa (90 psi).

(10) Inadequate ramp clearance for ramp inclines of 15 degrees.

Testing will provide SDDCTEA the data necessary to analyze and assess the transportability capabilities and limitations of the equipment. Specific agencies are responsible for certain aspects/modes of transportability, and these agencies consult with and report their findings to SDDCTEA for inclusion in the SDDCTEA final engineering analysis. The agencies and their responsibilities are referenced in applicable test procedures herein. Direct consultation with SDDCTEA for guidance and verification of requirements and procedures is encouraged.

MIL-STD-1366E,[2] Transportability Criteria, is the primary document for all modes of transport per DOD Instruction 4540.07. This standard establishes basic transportability interface criteria for use by the DOD acquisition community, to include the private sector, in the development and shipment of items of materiel. The standard covers dimensional and weight limitations for all modes of transport to ensure that new and modified systems meet the interface requirements of the Defense Transportation System (DTS) and the DTS lift assets. It also covers lifting and tiedown provisions, containerization criteria, overloads, assembly/disassembly, air delivery, shelter criteria, transportability testing, and modeling and simulation of the transportation environment.

In regard to Terminals Handling and Movement, the International Organization of Standardization (ISO) Standard 1496/1[3] contains specifications and tests which are required for American National Standards Institute/International Organization of Standardization (ANSI/ISO) certification of all intermodal freight containers but the contents may require rail impact testing. SDDCTEA accepts such certification of intermodal freight containers in lieu of additional transportability testing. Therefore, the provisions of this TOP need not be applied to certified containers. In the event certification is sought for a container or rigid-wall shelter, a list of ANSI/ISO test facilities may be obtained through SDDCTEA, ATTN: SDTE-DPE, Building 1990, 709 Ward Drive, Scott AFB, IL 62225.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

2.1.1 Slinging and Tie-down Attachments.

Item	Requirement
Bedplate/Embedded channels	Vertical pull restraint
Deadman anchors	Longitudinal and lateral pull restraints
Boom/Overhead crane anchors	Vertical (up/down) load application
Horizontal load application device	To apply load in longitudinal and lateral direction
Blocking, tie-down chains or straps	To restrain item to bedplate or deadman anchor
Chains, cables, Key Flex or Roundslings	To apply vertical loads

2.1.2 Rail Transportability.

Testing requirements are addressed in TOP 1-2-501.[4]

2.1.3 Road Transportability.

Item	Requirement
Automotive road courses	For road transport and mobility/handling testing
Recovery vehicles	For recovery vehicle test operations

2.1.4 Marine Transportability.

Item	Requirement
Marine vessel	Means of loading cargo with ship crane
Dockside or on-board	Trial loading and unloading

2.1.5 Terminals Handling and Movement.

Item	Requirement
Materials handling equipment (MHE)	Transportation of item
Sling cables and fittings	Lifting and drop test
Concrete pad	Drop test surface
Towing bar bridle and safety chains	Skid resistance testing
Quick-release crane hook	Mechanism for release of item for drop testing

2.1.6 Air Transportability - Fixed Wing Internal.

Item	Requirement
Fixed-wing aircraft	Trial loading
Cargo handling equipment	To assist in loading material in aircraft

2.1.7 Air Transportability - Rotary Wing Internal.

Item	Requirement
Helicopter	To perform form-fit function test loading
Cargo handling equipment	To assist in loading material in aircraft
Tie-down fittings and tie-down devices	To restrain item to helicopter's cargo deck

2.1.8 Air Transportability - Rotary Wing External.

Item	Requirement
Test helicopter	To perform flight demonstration
Chase helicopter equipped with video equipment	For video and photographic documentation
Boom/overhead crane	To perform static sling trials
Spreader bar or theodolite	Simulate helicopter's cargo hooks distance for dual-point lift
Standard sling sets	Rigging of test item for static/flight demonstration
Rigging materials including cargo straps, nylon cord, cotton webbing, tape	Restraint of all internal and external components for flight test

2.1.9 Air Transportability - Airdropped Materiel.

Item	Requirement
Fixed-wing aircraft	To perform airdrop/Low Altitude Parachute Extraction (LAPE)
Static drop facility	To perform ground impact test
Slings, parachutes, and/or airdrop platforms	Rigging of test item for airdrop
Rigging materials	Restraint and cushioning of all components for airdrop
Boom/overhead crane	Load placement for rigging
Aircraft loader	Load items into aircraft
High-speed film/video equipment	Document airdrop characteristics

2.2 Instrumentation.

2.2.1 Slinging and Tie-down Attachments.

Devices for Measuring	Measurement Accuracy
Force	± 1% of reading
Sling length	± 1 cm (± 0.4 in.)
Sling angle	± 1 degree
Time	± 1 second

2.2.2 Rail Transportability.

Testing requirements are addressed in TOP 1-2-501.

2.2.3 Road Transportability.

Devices for Measuring	Measurement Accuracy
Distance (brake stopping)	± 0.1 m (± 0.3 ft)
Distance (road)	± 0.1 km (± 0.06 mi)
Speed	± 0.1 km/hr (±0.06 mph)
Weight	± 1% of reading
Physical dimensions	± 1 cm (± 0.4 in.)

2.2.4 Marine Transportability.

Devices for Measuring	Measurement Accuracy
Approach and departure angles of test item	± 1 degree
Ground clearance of test item	± 1 cm (± 0.4 in.)
Time (rigging time)	± 1 minute
Time (voyage time)	± 1 minute
Acceleration/deceleration	± 1 % of reading
Strain	± 1% of reading
Vessel pitch, roll and yaw angles	± 1 degree
Ramp angles of approach, departure and crest	± 1 degree

2.2.5 Terminals Handling and Movement.

Devices for Measuring	Measurement Accuracy
Shock/vibration	± 1% of reading
Force	± 1% of reading
Weight	± 1% of reading
Height (drop tests)	± 1 cm (± 0.4 in.)
Deflections (stackability)	± 0.2 cm (± 0.08 in.)

2.2.6 Air Transportability - Fixed Wing Internal.

Devices for Measuring	Measurement Accuracy
Weight	± 1% of reading
Physical dimensions	± 1 cm (± 0.4 in.)
Bogie articulation	± 1 degree
Tire Pressure	± 7 kPa (±1 psig)

2.2.7 Air Transportability - Rotary Wing Internal.

Devices for Measuring	Measurement Accuracy
Weight	± 1% of reading
Physical dimensions	± 1 cm (± 0.4 in.)

2.2.8 Air Transportability - Rotary Wing External.

Devices for Measuring	Measurement Accuracy
Weight	± 1% of reading
Center of Gravity location	± 2.5 cm (± 1 in.)
Ambient temperature	± 2.0 ^{o}C (± 3.6 ^{o}F)
Wind speed	± 1 knot
Wind direction	± 30 degrees
Angle of inclination of load when suspended (static test)	± 1 degree

2.2.9 Air Transportability - Airdropped Materiel.

Devices for Measuring	Measurement Accuracy
Vertical distance (ground impact test)	± 1 cm (± 0.4 in.)
Time (rigging)	± 0.1 hour
Position (during airdrop)	± 2 meters (± 7 ft)
Time (frequency response)	± 200 m/sec (± 656 ft/sec)
Impact velocity	± 0.5 m/sec (± 1.6 ft/sec)
Acceleration	± 10% of reading

3. REQUIRED TEST CONDITIONS.

a. Coordinate test requirements and procedures with SDDCTEA and the applicable certification agency prior to conducting any and all transportability tests. In most cases, the representative(s) desire to witness testing.

b. The use of spreader bars is not permitted for testing purpose unless approved by SDDCTEA or the appropriate service transportability agent. Ensure that stowage is provided for the spreader bars on the item as basic issue item (BII) equipment. If required, use spreaders bars during provision testing.

c. Do not use shackles as lifting, equipment tie-down, or multipurpose provisions unless they meet the requirements of a high strength, safety (bolt/nut) anchor shackle in RR-C-271D.[5]

d. Ensure that the test item is in the designed load configuration – full payload configuration (real or simulated payload). The gross weight condition or the gross weight rating (GWR) of the test item, whichever is greater, is mandatory; other load conditions (e.g., curb weight) are as required. Use of real payload/cargo is required of most test procedures to verify survivability following the shock or vibration environment induced.

e. Specific vehicle configuration standards are defined in Military and Federal standards.

(1) The following are standard definitions derived from MIL-STD-209K[6]:

(a) Gross weight is defined as the weight of the basic equipment plus the weight of any associated support items of equipment and cargo attached to, contained within, or projected as payload for the equipment (e.g., shelter). The weight of ammunition, fuel, water and lubricant necessary to render a system combat ready are considered as payload and included in the gross weight. The gross weight equals the gross vehicle weight rating (GVWR) or the maximum projected weight of the equipment, which ever is greater.

(b) GVWR is defined as the unloaded vehicle weight, including all fluids, and its maximum payloaded (to include the weight of the crew), where the payload weight is based upon the manufacturer's rating of the structural capability of the vehicle.

(2) The Federal Motor Vehicle Safe Standard (FMVSS) 571.3 "Definitions"[7] provides specific definitions for the following commercial vehicle configurations:

(a) GVWR means the value specified by the manufacturer as the loaded weight of a single vehicle.

(b) Curb weight means the weight of a motor vehicle with standard equipment; maximum capacity of engine, fuel, oil, and coolant; and, if so equipped, air conditioning and additional weight optional engine.

(c) Gross combination weight rating (GCWR) means the value specified by the manufacturer as the loaded weight of the combination vehicle.

(d) Gross axle weight rating (GAWR) means the value specified by the vehicle manufacturer as the load carrying capacity of a single axle system, as measured at the tire-ground interfaces.

(3) Other pertinent vehicle configurations may be required based on the test plan or physical circumstance. Documentation of the vehicle configuration is critical. Written and photographical documentation is required.

f. Ensure that the test item has been fully serviced (i.e., fuel, oil, coolant) or serviced to the levels specified in the rigging/tie-down procedures or applicable equipment publications. All auxiliary equipment must be installed and secured properly.

g. Ensure that Standing Operating Procedures (SOPs) for the specific test procedures are adhered to at all times.

4. TEST PROCEDURES.

4.1 Slinging and Tie-down Attachments.

The objective of this subtest is to determine whether the slinging and tie-down attachments of military equipment comply with dimensional and/or directional limits and design, positioning and strength requirements for transportability.

4.1.1 Method.

a. Categorize the slinging and tie-down attachments regarding equipment type (Type I-II) in accordance with MIL-STD-209K. Inspect the provisions regarding location to determine if any interferences with functioning equipment exist and that maximum accessibility is provided. Measure the provisions to determine compliance with minimum dimensional requirements. Specific location, clearance, dimensional and directional requirements are defined in MIL-STD-209K. Employment of a spreader bar for lifting is not preferred unless given SDDCTEA's prior approval.

b. Subject the slinging and tie-down provisions to calculated lateral, longitudinal, and vertical forces (up and down), as applicable, specified by MIL-STD-209K and verified or provided by SDDCTEA. Perform static lift to establish lifting parameters (i.e., sling lengths, sling legs angle, item attitude in suspension) for marine movements. Prior to load application, secure the equipment to a bedplate, deadman, or some means of attachment for anchoring purposes. Record (photograph if possible) the securement method and equipment employed. Load application will be provided by a dynamometer, crane, and/or a hydraulic actuator system. Accomplish the provision loading for the durations specified in MIL-STD-209K. Measure the loads with calibrated devices such as load cells. Measure the sling leg angles of vertical loadings. Record and photograph any weld cracking or visible permanent deformation or set in the provision(s) or other structural component resulting from load application.

c. Equipment with a helicopter External Air Transport (EAT) requirement is often referred to as Helicopter Sling Load (HSL) also satisfies MIL-STD-913A.[8]

d. Navy/U.S. Marine Corps (USMC) equipment with internal air transport (IAT) requirements shall also comply with the Naval Air (NAVAIR) Systems Command Cargo Restraint Requirements.

e. Air droppable materiel tie-downs and attachments are tested for conformance with MIL-STD-814D (see Paragraph 4.9).[9]

f. Aircraft cargo tie-down device testing is described in MIL-DTL-25959F.[10]

4.1.2 Data Required.

The following data are required:

a. Classification of all slinging and tie-down provisions.

b. Measurements of slinging and tie-down attachments, including number of provisions and locations, physical dimensions, directional capabilities.

c. Record of any sling-to-item interference or provision accessibility problems.

d. Description of procedure employed in securing test item for load application (photographs when available).

e. Measurement of static force(s) applied, the direction of each static pull, and the slinging/tie-down attachment(s) subjected to the pull.

f. Sling lengths and angle measurement(s) for vertical slinging static pull testing, apex height, item's attitude in suspension.

g. Identification of spreader bar(s) employed, as necessary, and the configuration of the lifting assembly (photographs when available).

h. Record of any permanent deformation or set or weld cracking resulting from testing (photographs when available).

4.2 Rail Transportability.

The objective of this subtest is to determine whether the test item meets the specified requirements for rail transportability certification.

4.2.1 Method.

Rail impact testing is required of all items designated for rail transport to verify the structural/functional integrity of the item and its integral part, the adequacy of the tie-down system and the tie-down procedures. Based on the Product Manager (PM) or contractor's developed rail tie-down procedures, any special railcar requirements are submitted to SDDCTEA for approval and then to a test activity for rail impact testing. An engineering analysis is performed by SDDCTEA to determine if the test item's weight and physical dimensions are compatible with North Atlantic Treaty Organization (NATO) rail facilities. The requirements for unrestricted and restricted transport are specified in MIL-STD-1366E. The physical dimensions of the item and tie-downs must fall within prescribed templates illustrated in MIL-STD-1366E. Blocking and bracing is not permitted. Prior to rail impact testing, MIL-STD-209K tie-down provision strength testing (para 4.1) must be accomplished to verify the strength of the tie-down provisions. Following successful tie-down provision testing, rail impact testing must be accomplished in accordance with TOP 1-2-501.

4.2.2 Data Required.

The data required are as listed in TOP 1-2-501.

4.3 Road Transportability.

The objective of this subtest is to determine whether the test item can be transported over and off highways.

4.3.1 Method.

SDDCTEA is responsible for performing an engineering evaluation of equipment designated for road transportability. Weight and physical characteristics will be compared against requirements for highway transport. Any restrictions will be noted. Following physical parameter considerations, a series of tests including steering, braking, shock, vibration and road transport will be accomplished to assess the safety, mobility and handling characteristics of the item.

a. Transported Configuration.

(1) Prepare the test item for shipment in accordance with the procedures contained in the appropriate technical manuals for movement over highways. Load, block, brace, and tie down the item on a semitrailer or other vehicle designated as the prime mover. (If the technical manuals do not contain tie-down instructions, use procedures recommended by the test agency and concurred with the developing agency, where appropriate.) Representative tie-down configurations are illustrated in SDDCTEA Pamphlet 55-20.[11] Once the item is securely loaded, measure the combination's physical parameters including width, height, length, gross weight, and axle wheel loading. Record the measurements and weight. To ensure general unrestricted Continental United States (CONUS) highway transport, vehicles and vehicle cargo combinations must not exceed the following constraints:

Height	412 cm (162 in.)
Width	244 cm (96 in.)
Length	10.7 m (35.0 ft) for a single unit 16.8 m (55.0 ft) for a combination unit 13.7 m (45.0 ft) for a semitrailer
Single axle load	9,080 kg (20,000 lb)
Tandem axle load	15,436 kg (34,000 lb)
Triple axle load	19,068 kg (42,000 lb) (four states have lower limits)
Gross vehicle weight †	36,320 kg (80,000 lb)

† The gross vehicle weight constraint is also dependent on the highway bridge formula, presented in MIL-STD 1366E, paragraph 5.1.2.2.

(2) The weight and dimensional constraints for vehicles and vehicle cargo combinations moving on foreign highways without permits constitute the foreign legal limits. These weight and dimensional limits vary from country to country. The legal limitations for foreign highways are shown in the Limits of Motor Vehicle Sizes and Weights,[12] published by the International Road Federation. Because such a wide variation exists in the foreign legal limits and some countries have limited highway systems, the following constraints are recommended to achieve general unrestricted transport in most NATO countries:

Height	401 cm (158 in.)
Width	244 cm (96 in.)
Length	12 m (39 ft) - single unit
	15 m (49 ft) - combination unit
Single axle load	10 metric tons (22,050 lb)
Tandem axle load	16 metric tons (35,290 lb)

(3) Conduct steering and handling tests and measurements in accordance with International Test Operations Procedure (ITOP) 2-2-609(1)[13] to evaluate the turning characteristics of the vehicle and test load at intersections and over the road for unrestricted movement on principal highway systems.

(4) Conduct instrumented emergency brake stopping tests at 8 km/hr (5 mph) and in 8 km/hr (5 mph) increments up to the vehicle's maximum speed or 90 km/hr (56 mph), whichever is lower. Accomplish testing on a dry, smooth, level, hard-surfaced road free of loose materials. Measure wheeled vehicle brake drum temperatures following each brake stop and do not permit the temperatures to exceed 120 °C (248 °F) during the test. Note any deviations from a straight line path during the test and record the stopping distances measured. Stop the test once an unstable condition is experienced. Conduct emergency brake stopping tests at speeds up to 8 km/hr (5 mph) while moving in the reverse direction. After each emergency stop test, inspect the load and tie-downs to determine the amount of load shift, condition of blocking and bracing, and evidence of any displacement or damage. Following these tests, accomplish operational and functional inspections. Note any load shift and/or damage to blocking and bracing or the item itself.

b. Highway and Off-Road Testing. Highway and off-road (cross-country) tests are performed to determine the capability of the test item and component assemblages, while mounted as on-board cargo on the prime mover, to withstand the shock and vibration to which a military vehicle is subjected when traveling over primary and secondary roads at speeds varying between 40 and 90 km/hr (25 and 56 mph), and over cross-country level and hilly terrain at speeds varying between 24 and 56 km/hr (15 and 35 mph). These tests are conducted on test courses representing typical primary and secondary roads and cross-country terrain. Distance traveled and type of terrain should be representative of the test item's Operational Mode Summary/Mission Profile (OMS/MP). In the event that no OMS/MP exists, use Table 1 as a guide.

(1) Load and secure the test item on its prime mover. Transport the item over the pre-selected courses including portions of primary (paved) and secondary (improved dirt and gravel) roads, and level and hilly cross-country terrain. Speeds will coincide with those specified in the OMS/MP or the applicable course SOP. The routes selected must provide an adequate representation of the above surfaces for each type of equipment tested and must lend themselves to repeated use to form a comparative base for future testing. A towed test item (i.e., trailer-mounted), when required, is subjected to the same tests. Accomplish visual and functional inspections following each course segment and note the results.

TABLE 1. HIGHWAY AND CROSS-COUNTRY MILEAGE FOR TRANSPORTABILITY TESTING ‡

GROUP	TYPE EQUIPMENT	HIGHWAY MOVEMENT 30 PERCENT	SECONDARY ROADS (PERRYMAN) 40 PERCENT		CROSS-COUNTRY (CHURCHVILLE) 30 PERCENT		TOTAL
			Dirt	Gravel	Hilly	Level	
		km (mi)	km (mi)	km (mi)	km (mi)	km (mi)	km (mi)
I	Bridges. Road and airfield surfacing equipment. Air drop equipment. Shelters, etc.	97 (60)	64 (40)	64 (40)	48 (30)	48 (30)	322 (200) in a 24-hour period.
II	Boats and marine equipment. Construction equipment (scrapers, bulldozers, loaders, etc.). Vehicles such as trucks and trailers. Combat vehicles such as tanks and personnel carriers.	241 (150)	161 (100)	161 (100)	121 (75)	121 (75)	805 (500)
III	Service support equipment (field laundries, bath units, printing equipment, etc.). Materials handling equipment (forklifts, cranes, etc.). POL handling equipment (pumps, filters, separators, etc.).	386 (240)	257 (160)	257 (160)	193 (120)	193 (120)	1287 (800)
IV	Electromechanical equipment (generators, air conditioners, welders). Maintenance tools and equipment (repair shops, tool sets, etc.).	483 (300)	322 (200)	322 (200)	241 (150)	241 (150)	1609 (1000)
V	Sensitive or high value items (missiles, radar systems, electronic equipment, sensors, fire control centers, etc.).	724 (450)	483 (300)	483 (300)	362 (225)	362 (225)	2414 (1500)

‡ Based on test courses described in TOP 1-1-011.[14] Applies to transported, not self-propelled items.

1. Unless otherwise stated in the guidance document, the miles and percentages shown will be used.
2. Proper safety regulations will be adhered to when using the test courses.
3. Speeds will be determined by specified type of test courses.
4. Where practical, transported items will be tested in conjunction with durability tests of appropriate carrier vehicles

(2) If the test item is a self-propelled vehicle, vehicle recovery operations are included in a portion of the highway and off-road testing. Using the appropriate recovery vehicle, or the vehicle specified in the requirements document, connect the test item to the recovery vehicle with standard towbars to the towing pintle or lifting and tie-down provisions per the test item's technical manual. Inspect the combination to insure that the electrical connections for lighting and all towing apparatus and connections are compatible. Note and photograph any vehicle interferences or incompatibilities. Upon the resolution of the interferences or incompatibilities, if any, tow the item with the recovery vehicle over sections of highway, secondary, and cross-country courses. While testing towing maneuvers, inspect the combination to identify any restrictions to movement and to determine whether proper driver visibility is maintained. Accomplish the following maneuvers to determine compatibility:

(a) Negotiate four 90-degree turns in alternate directions.

(b) Back up the recovery vehicle with the test item in tow in a straight line to a distance of 15 m (50 ft).

(c) Back up the combination in both left and right turns to simulate backing the item into a maintenance shed or stall.

(3) Conduct shock and vibration testing of vehicles and cargo in accordance with ITOPs 2-2-808(1)[15] and 1-2-601.[16]

4.3.2 Data Required.

a. Weight, and gross, curb, and axle loading.

b. Physical dimensions.

c. Emergency braking initiation speeds and distances, and record of any deviation from a straight line during the brake stops.

d. Record of any load shift, or damage to the blocking and bracing or equipment.

e. Record of course type, speeds, and distance traveled accrued during road test.

f. Record of recovery vehicle(s), vehicle configuration (towed from front or rear), road course type, distance traveled, and speeds accomplished during vehicle recovery operations.

g. Record of any vehicle interferences or incompatibilities between the recovery vehicle and test vehicle. Photographs illustrating the interference or incompatibility are desired.

4.4 Marine Transportability.

The objective of this subtest is to determine whether the test item can be transported by marine vessels. Marine transportability is composed of lifting and vessel and test item compatibility in accordance with MIL-STD-209K and MIL-STD-1366E, respectively. The U.S. dry cargo fleet consists of four conventional ship types: breakbulk, container, barge carriers, and roll on/roll off (RORO). Various combinations of these four ship types also exist. The following paragraphs offer a short summary of each type. Specific measurements and space constraints are detailed in MIL-STD-1366E.

a. Breakbulk General Cargo Ships. The hold configuration on most breakbulk ships is generally the same, consisting of five to seven holds. Each hold has three to five decks and hatch covers that allow access to the different decks. Cargo operations on breakbulk vessels are lift on/lift off (LOLO). Each hold on a breakbulk vessel is served by ship's gear.

b. Containerships. Modern containerships, to include combination ships, are designed to carry all or part of their cargo load in containers. The containership allows containers to be secured without the use of dunnage. Containerships also have the capability for transporting containers that are stacked on the vessel deck.

c. Barge Carriers. The Lighter Aboard Ship (LASH) and Sea Barge (SEABEE) transportation systems operate similar to a containership. In these systems, cargo is stowed in unitized lighters or barges. The barges or lighters are then stowed aboard a barge carrier or mother ship. One major difference between containerships and barge carriers is the amount of cargo that barges or lighters can handle. LASH lighters and SEABEE barges have cubic capacities of 570 and 1130 m^3 (20,000 and 40,000 ft^3), respectively. The barge carrier/mother ship is self-sustaining. The LASH system uses a gantry crane to load its lighters, while the SEABEE system has an elevator to load its barges.

d. RORO Ships. The RORO ship is primarily a vehicle transporter that allows vehicles to drive on or off the ship via ramps. RORO cargo includes wheeled, tracked, self-propelled, and towed vehicles and equipment. Most modern RORO vessels not only carry vehicles, but also carry a combination of containers and/or breakbulk cargo. A series of external and internal ramps facilitate the loading and discharge of RORO cargo. To maintain safe operations, the ramp angle for loading and unloading procedures is no greater than 15 degrees.

4.4.1 Method.

a. Vessel and Test Item Compatibility. Upon completion of physical parameter measurements and sling and tie-down testing in accordance with MIL-STD-209K (para 4.1), vessel and test item compatibility is evaluated. Using MIL-STD-1366E, SDDCTEA determines the compatibility of the test item with marine stowage and handling provisions of the various oceangoing vessels. A comparison of test item physical characteristics with the hatch and hold dimensions and cargo handling gear is made. From this comparison an estimate is made regarding the capability of the item to be transported by various types of vessels. An evaluation is also made of the capabilities of amphibious vehicles and landing craft with respect to loading

and securing the test item and unloading it onto the beach. The study, depending on requirements, encompasses the physical aspects of ramp negotiation, roll on/roll off maneuvering, loading, and tie-down arrangements. Complete logistics-over-the-shore (LOTS) performance test requirements are addressed in TOP 2-2-520.[17]

b. Cargo Movement. If feasible, conduct a trial loading of the test item on actual oceangoing vessels, using the ship's cargo handling gear or customary dockside lifts. Once loaded, stow and secure the test item using specific cargo restraints. Representative marine tie-down configurations are illustrated in TEA Pamphlet 55-22.[18] Note the presence of test item combustibles, if any. Apply recording instrumentation, including strain gages and accelerometers, to select points of the item to record angles of pitch, roll and yaw to correlate the environmental data logged by the ship during its voyage. When practical, inspect the test item periodically during transport in addition to the beginning and end of the voyage.

4.4.2 Data Required.

a. Type of ship or simulation gear used.

b. Angles of approach and departure for test vehicle.

c. Ability of test vehicle to negotiate a 15-degree ramp.

d. Minimum ground clearance of test vehicle (identify location).

e. Equipment used in loading and any difficulties encountered.

f. Location of stowage.

g. Method of securing item.

h. Length of time and number of people required to rig the test item for shipment.

i. Measurements of acceleration, deceleration, and strain.

j. Duration of simulation or voyage, and angles and periods of pitch, roll, and yaw encountered.

k. Condition of bracing and securing gear during and after the voyage.

l. Direction of shift, if any.

m. Amount and type of damage, if any.

n. For landing craft trials, vehicle and craft ramp angles of approach, departure, break and crest.

o. For landing craft trials, gradeability capabilities or limitations of the test item.

4.5 Terminals Handling and Movement.

The objectives of this subtest are to determine the ability of:

a. The test item to withstand the mechanical stresses experienced when moved with MHE, in vehicles, or by personnel.

b. The packaging and packing methods to provide protection to the contents.

4.5.1 Method.

The procedures referenced in this paragraph provide simulations of the conditions typically encountered by freight containers, shelters, palletized loads, and equipment contained in transit cases or shipping crates in the course of their handling and movement at points of embarkation for and debarkation from multi-mode (rail, highway, marine, air) transportation media.

a. Standardization of Containers and Shelters. Intermodal freight containers and members of the Army Standard Family of Shelters (ASFS) designated as ISO shelters must be certified as meeting the requirements for multi-mode transport, or be tested to ISO Standard 1496/1 (para 1 of this TOP for ANSI/ISO test facilities information) and satisfy the engineering and design requirements of American Society of Testing and Materials (ASTM) E1925-97.[19]

b. Forklift Handling. The adequacy of the forklift provisions of shelters, pallets, and shipping crates, and their ability to be safely lifted and restrained during movement by forklift without experiencing more than superficial damage is determined in this procedure. Given the variety of MHE types available at transportation terminals, any forklift of sufficient capacity and tine characteristics (load center) may be used; tactical, conventional, or non-Department of Defense (DOD). The impact of forklift handling on the test item, not the ability of accepted MHE to handle its load, is the issue, thus allowing this flexibility in MHE application. Inspect the item to identify the forklift pockets, and determine any recommendations and restrictions listed on the data plates. The size of most shelters necessitates the use of forklifts with tines of at least 2.4 m (8 ft) in length or the application of tine extenders. The procedure for testing shelters is contained in ASTM E1925, paragraph 10.5, Forklift Handling Test, while ASTM-D6055-96[20] and ASTM-6179-07[21] provides a means of testing unitized loads and large shipping cases and crates. In each case, load the test item to its gross shipping weight (GSW), with center of gravity as near as practicable to the actual service conditions, and affix the load to the forklift with slack safety chains or cabling to minimize the possibility of loss of the load.

c. Towing and Dragging. The ability of shelter skids, pallets, and shipping crates to withstand lateral loads incurred during placement adjustments of these items and their movement in the absence of forklifts is determined. Load the test item to its GSW, with center of gravity as near as practicable to the actual service conditions. Shelters with skids should be tested in accordance with ASTM E1925, paragraph 10.28, and pallets and shipping crates with skids are

presented in ASTM-D6055-96, Test Method D, paragraph 9.4. Connect a load cell to the towing medium in order to measure and thus control the applied force.

d. Lifting. The adequacy of lifting provisions and the structural integrity of the test item when lifted are examined in this test. Test procedures for lifting in general and for external (rotary wing) air transport are discussed in paragraphs 4.1 and 4.8, respectively, of this TOP. Procedures for the testing of shipping crates are provided in ASTM-D6055-96, Test Method E-Grabhook Test Procedures, paragraph 10-1 and Test Method F-Sling Test Procedure, paragraph 10.2. Intermodal freight containers shall be certified as compliant with ISO Standard 1496/1 or tested to this document.

e. Drop Tests. The structural integrity of the test item and the effectiveness of any internal shock attenuation mechanisms are determined in this series of tests. Procedures relevant to handling of shipping crates and palletized loads (except for munitions) such as corner drop, edgewise drop, and free fall drop are found in the following documents:

Rotational Corner Drop Test ASTM-D6179-07, Test Method B
Rotational Edge Drop Test, ASTM-D6179-07, Test Method A
Unsupported Free Fall Drop Test, ASTM-D6179-07, Test Method D
Rotational Flat Drop Test, ASTM-D6179-07, Test Method C

The free-fall test is limited to packages or containers of up to 70 kg (150 lb) in weight and not exceeding 152 cm (60 in.) on any edge or diameter, whereas the other tests of ASTM-D6179-07 are intended for materiel with physical characteristics exceeding these parameters. Separate procedures for flat (free-fall) and rotational (edgewise) drop testing of shelters both with and without skids are contained in ASTM E1925, paragraphs 10.29 (without skids) and 10.30 (with skids). Procedures for drop testing of munitions are available in ITOP 4-2-601.[22] Each of these tests employs a quick-release mechanism at the apex of the rigging to release the test item from its point of suspension at the initiation of the drop. If the test item has no provisions for protection from impact by falling rigging, the sling set is tethered to the overhead crane hook such that it neither strikes the test item nor interferes with its motion in dropping. The test item may be instrumented to measure mechanical shock and vibration, and strain incurred by selected components or members. Any shock and vibration measurements of internal components or members should be accompanied by comparable recordings at the base of the test item (forcing function).

f. Rough Handling. This procedure is used to determine the capability of the test item to withstand the shocks normally induced by loading and unloading of equipment in routine service usage, not to simulate handling the logistics shipping environment. Measurement of shock and vibration imparted to the test item must be consistent with the guidance provided for drop testing (para 4.5.1e)); however, the application of instrumentation may not be feasible in the case of small items. The guidance provided in MIL-STD-810F,[23] method 516.4, procedure IV, Transit Drop, is applicable for equipment packaged in its transit case(s) as prepared for field use. Simulation of conditions experienced by items carried by individuals on their person or as unsecured cargo in trucks is described in ITOP 4-2-602.[24] Munitions, rifles, rockets, radios, and mortars are covered in this latter document.

g. Cargo Compatibility. Methods for determining the susceptibility of vehicles for loading and unloading of cargo are found in TOP 2-2-537.[25] This document prescribes procedures for trucks, aircraft, ships, and railroad car carriers. These tests can usually be integrated with other terminals handling and movement procedures.

h. Stackability. The ability of shipping crates or packages to withstand loads such as these imposed on the bottom container in a stack, or support loads on their tops, with or without dunnage present, is determined through the use of the test procedures of Superimposed Load Test; Stackability, with Dunnage , and Superimposed Load-Test; Uniformly Distributed, without Dunnage as prescribed in ASTM-D4169. Strain measurements of stressed members may be taken if required.

4.5.2 Data Required.

a. Results of visual inspections, dimensional records, and operational checks, the latter if appropriate, for pre- and post-test examinations.

b. Descriptions and photographs or diagrams of loading the test item, to include any blocking, bracing, or cushioning.

c. Descriptions and photographs of the test facility, including means of item handling and/or slinging, and sling capacity.

d. Measurement of heights of drop tests, and the orientation of the item for each test iteration.

e. Dimensions, type, location, configuration, and number of skids and/or forklifting provisions.

f. Description and photograph of any incompatibility of the container, shelter, or package with its storage or transportation medium.

g. Shock and vibration, or strain data.

h. Video record of forklifting, drop, and rough handling tests.

i. Gross and tare weights of the test item.

j. Prevailing meteorological conditions at the time of the test.

k. Measurements of any deflections obtained during stackability tests.

4.6 Air Transportability - Fixed Wing Internal.

The objective of this subtest is to determine the suitability of the test item to be transported by U.S. Air Force (USAF) and Civil Reserve Air Fleet (CRAF) fixed-wing aircraft.

4.6.1 Method.

Certification of military equipment for transport on USAF and CRAF aircraft is performed by the U.S. Air Force Air Transportability Test Loading Agency (ATTLA) through coordination with SDDCTEA. The required data for each test item are recorded and forwarded to ATTLA through SDDCTEA. Characteristic data for current fixed-wing aircraft are presented in Appendix A.

a. Item Inspection and Physical Characteristics. Inspect the item and record the location of, and data on, all tie-down, hauling, and lifting points. The lifting and tie-down fixtures must conform with the design criteria of MIL-STD-209K. Measure and record the weight and physical characteristic measurements of the item as listed in Table 2 and illustrated in Figures 1 through 3.

b. Forward the data recorded in paragraph 4.6.1a through SDDCTEA to ATTLA. ATTLA will perform an analysis of the test item measurements in accordance with MIL-HDBK-1791[26] to determine the item's suitability for transport on USAF aircraft. ATTLA provides the engineering analysis results and approval to USAF Air Mobility Command (AMC), USAF Air Combat Command (ACC) or U.S. Air Force Special Operations Command (AFSOC), which are responsible for certification of material. If the analysis determines that there are no significantly limiting factors involved in loading the item on all aircraft in the USAF fleet, ATTLA will issue a letter stating such through SDDCTEA. Should this analysis reveal that the test item or aircraft may be damaged during loading or transport of the item in aircraft, ATTLA will require a test loading of the item.

c. When required, coordinate test loading with ATTLA and the USAF operating commands. These agencies will conduct the test with particular attention paid to those factors highlighted as potential hazards to the aircraft and the test item during the analysis. All test loadings are conducted in accordance with MIL-HDBK-1791.

TABLE 2. TEST ITEM PHYSICAL CHARACTERISTIC MEASUREMENTS

MEASUREMENT	UNIT*
Dimensions	
Length	inches
Width	inches
Height at Front of Vehicle/Trailer	inches
Maximum Height	inches
Height at Rear of Vehicle/Trailer	inches
Forward Overhang [a]	inches
Forward Projection [b]	inches
Rear Overhang [c]	inches
Rear Projection [d]	inches
Forward Ground Clearance	inches
Mid-Wheelbase Ground Clearance	inches
Rear Ground Clearance	inches

TABLE 2 (Cont)

MEASUREMENT	UNIT*
Fifth Wheel/Pintle Distance [e]	inches
Fifth Wheel/Pintle Height [f]	inches
Landing Gear Pad Size (Trailers)	square inches
Kingpin/Lunette Height (Trailers)	inches
Wheel/Axle Measurements	
Bogie/Walking Beam Articulation [g]	degrees
Number of Axles	N/A
Distance from Front Axle to 2d Axle	inches
Distance from 2d Axle to 3d Axle	inches
Distance from 3d Axle to 4th Axle	inches
Wheelbase	inches
Number of Wheels on Each Axle	N/A
Tire Size	xxRzz
Tire Radius	inches
Tire Pressure	psig
Tire Contact Length	inches
Tire Contact Width	inches
Weight Measurements	
Gross Item Weight	pounds
Weight of Item on Each Axle	pounds
Weight Capacity of Each Tiedown Provision	pounds
Ratings	
Gross Item Rating	pounds
Rating of Each Axle	pounds
Rating of Suspension of Each Axle	pounds
Tire Load Rating at 55 mph	pounds
Fifth Wheel/Pintle Rating	pounds
Landing Gear Rating (Trailers) (One Leg)	pounds

[a] Distance from the forward-most portion of the item at the bottom to the center of the front axle.
[b] Distance from the forward-most portion of the item at the top to the center of the front pivot point (axle, kingpin, etc.).
[c] Distance from the rearward-most portion of the item at the bottom to the center of the rear axle.
[d] Distance from the rearward-most portion of the item at the top to the center of the rear axle.
[e] Distance from the center of the front axle to the center of the fifth wheel or pintle.
[f] Height of the top of the fifth wheel or the center portion of the pintle from the ground.
[g] Maximum articulation (without wheels leaving the ground) of any multi-axled trailer or truck rear. Defines the maximum ramp angle the item can negotiate while maintaining full load distribution on all axles.

*Note: Data are required in English units for direct comparison with aircraft specifications.

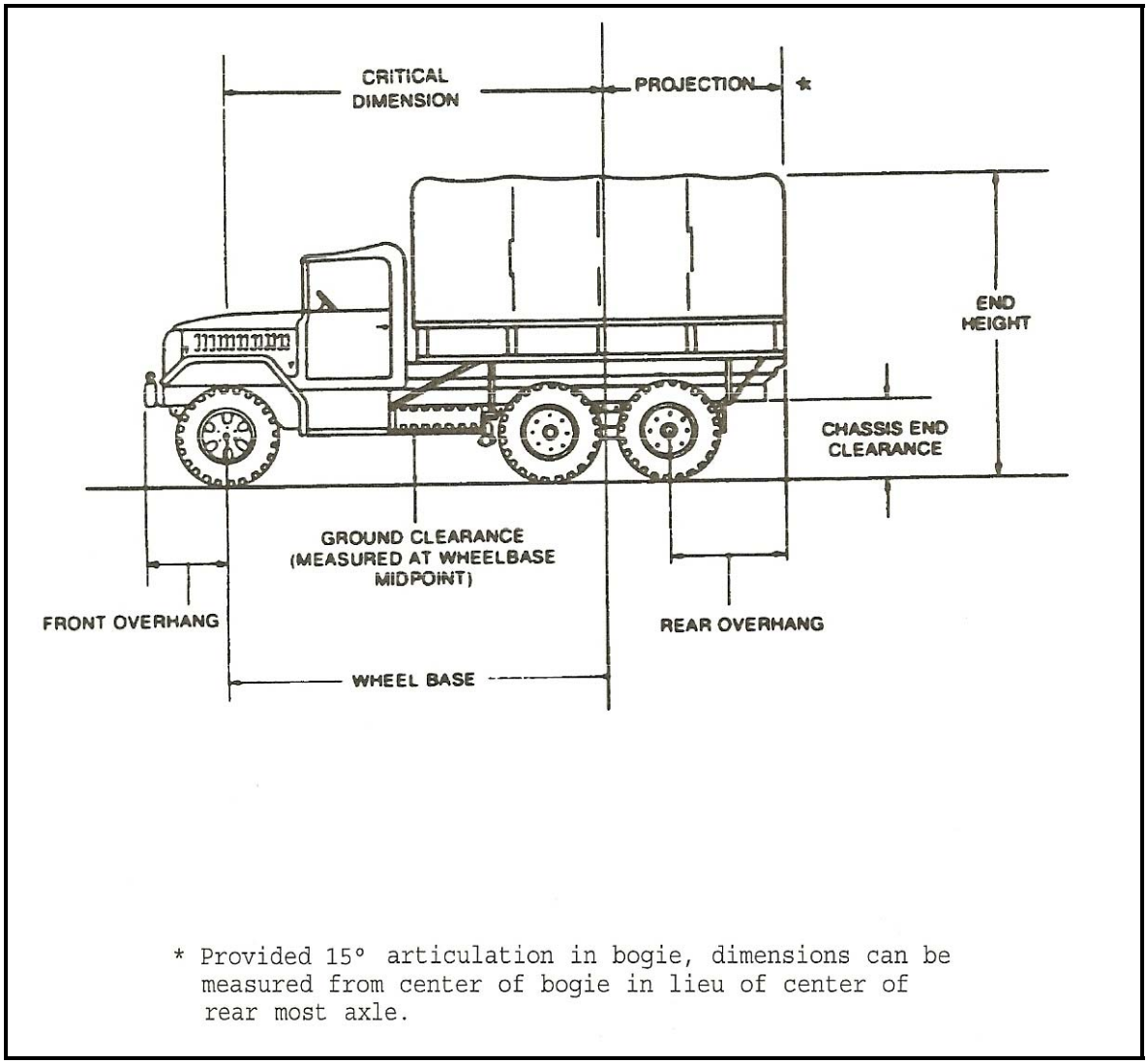


Figure 1. Illustration for determining dimensions of physical characteristics for a truck.

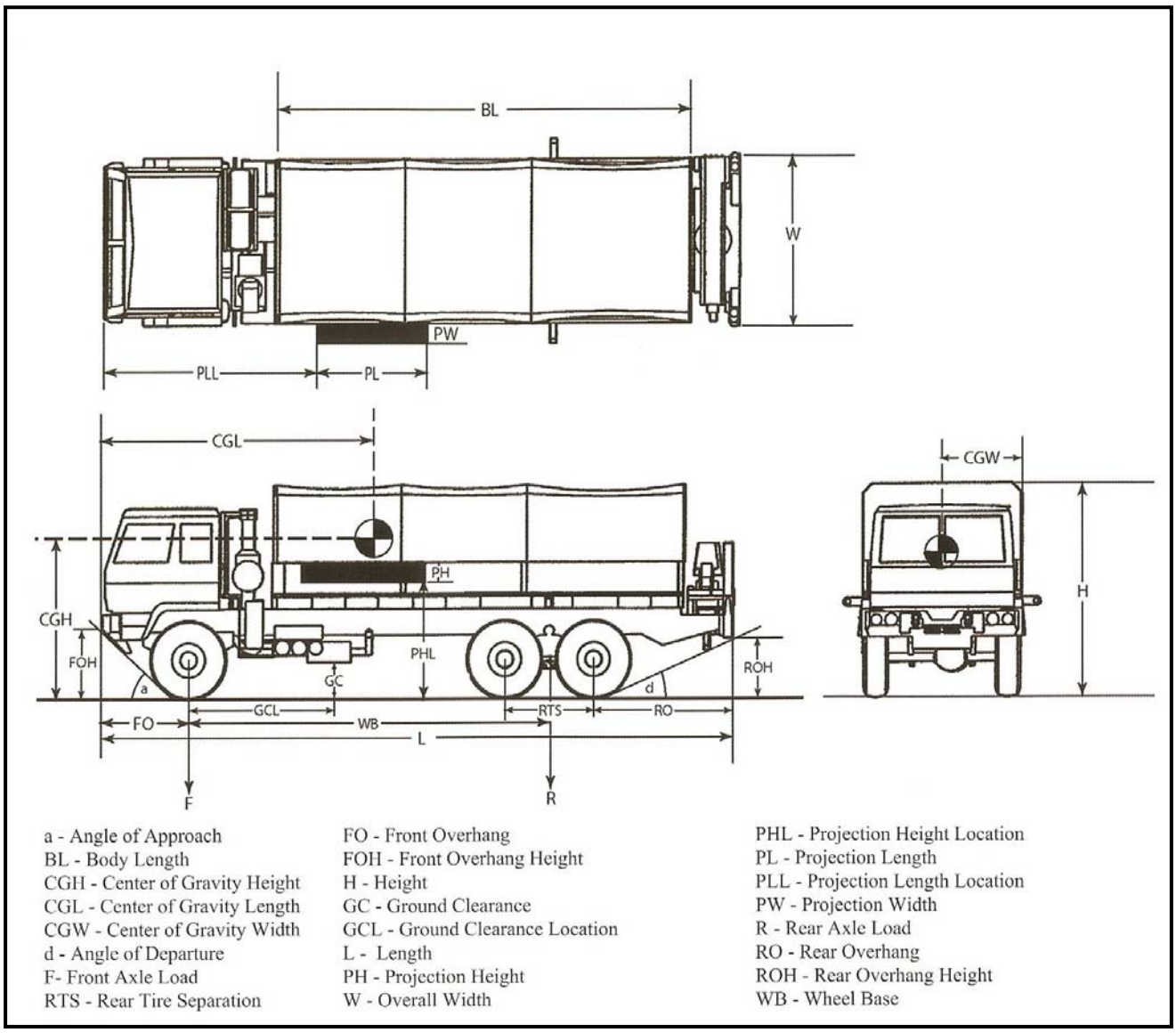


Figure 2. Illustration for determining dimensions of physical characteristics for a truck.

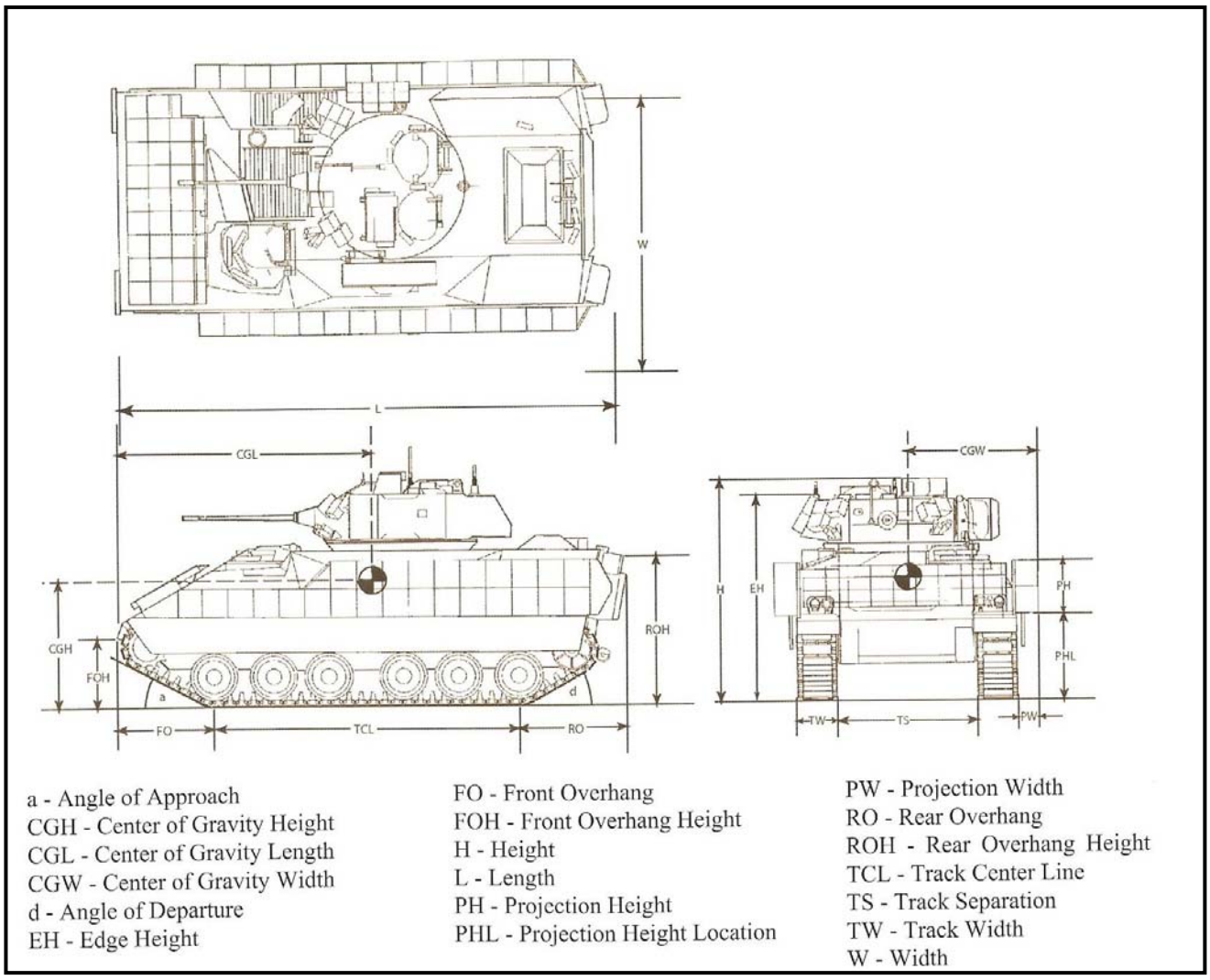


Figure 3. Illustration for determining dimensions of physical characteristics for a track vehicle.

4.6.1 Data Required.

a. Center of gravity of test item.

b. Maximum ratings of lift and tie-down provisions as determined by testing conducted in accordance with MIL-STD-209K.

c. All measurements contained in Table 2.

4.7 Air Transportability - Rotary Wing Internal.

The objective of this subtest is to determine the capability of the test item to be transported in an internal configuration by rotary-wing aircraft. The Aerial Delivery Engineering Support Team, AMSRD-NSR-WP-AD, of U.S. Army Natick Soldier Research, Development, and Engineering Center (NSRDEC) is responsible for certification of equipment transported internally via U.S. Army rotary-wing aircraft. U.S. Navy Naval Air Systems Command (NAVAIR) has been designated for U.S. Navy or USMC internal load certifications. The NSRDEC certification is based on an engineering evaluation of load characteristics and the tie-down provisions accomplished by NSRDEC, proof load testing of the tie-down provisions in accordance with MIL-STD-209K and a validation test loading, when deemed necessary. The NSRDEC engineering evaluation includes the following:

a. Determination of the helicopters that are capable of transporting the test item based on each helicopter's size and weight limitations specified in MIL-STD-1366E and provided as Appendix B.

b. Determination of restraint criteria based on aircraft requirements specified in MIL-STD-1366E and provided as Appendix B.

c. Calculation of tie-down provision proof loads.

d. Evaluation of load weight distribution versus aircraft floor and/or ramp loading limitations specified in individual helicopter technical manuals.

e. Determination of item clearances during loading and flight. An item must maintain 15 cm (6 in.) of vertical clearance and 13 cm (5 in.) of clearance on each side of the aircraft structure at all times during loading and flight.

4.7.1 Method.

a. Test the tie-down provisions in accordance with MIL-STD-209K (Paragraph 4.1). Compliance with MIL-STD-209K satisfies the crash load restraint criteria for military rotary-wing aircraft with the exception of the U.S. Army UH-60. The UH-60 12-*g* forward crash load restraint criterion will require additional testing or equipping the item(s) with a greater number of forward tie-downs. Each tie-down provision and its supporting structure shall withstand its proportionate share of the loadings. No visible permanent deformation or set in the provisions or supporting structure shall result from the application of the loads. All tie-down provisions must undergo proof testing. The contractor or manufacturer will provide a material analysis illustrating that the ultimate load is not less than 1.5 times the required design limit load for the provisions.

b. Conduct test loading of the item if the NSRDEC engineering analysis reveals that the characteristics of the test item are such that analytical means alone are insufficient to determine whether it meets the clearance, projection, overhang, and ramp cresting requirements. Load the test item in the designated aircraft and secure it in accordance with the procedures outlined in

FM 4-20.197.[27] During the test loading, document and photograph any special procedures for loading and/or tie-down developed. If any restrictions are revealed, attempt to disassemble the item to enable loading and document the disassembly required.

4.7.2 Data Required.

a. Item description and nomenclature.

b. Weight, dimensions, center of gravity and cubage of item.

c. Ground contact area (i.e., skids, tires).

d. Calculation of ground pressure = weight and ground contact area.

e. Number, location and load capacity and rating of the tie-downs.

f. Instructions for special servicing and preparation.

g. Orientation for flight, when critical.

h. Identification of cargo handling equipment employed, if any.

i. Precautions and procedures to be observed during loading or unloading.

j. Restrictions and clearances for loading, including ramp.

k. Reduction in vehicle and trailer tire pressure to meet floor loading requirements, if necessary.

l. Any disassembly of the item required for loading.

m. List of tie-down equipment employed.

4.8 Air Transportability - Rotary Wing External.

The objective of this subtest is to determine the capability of the test item to be transported in an external configuration by rotary-wing aircraft.

4.8.1 Method.

a. Inspect the test item lift provisions to determine the locations, type, and measurements of the provisions for conformance to MIL-STD-913A. Weigh the item and determine the center of gravity. Communicate this information to the AMSRD-NSR-WP-AD of NSRDEC who is responsible for performing an engineering analysis and developing draft rigging procedures. The engineering analysis determines which helicopters are capable of transporting the item. The maximum external payload capabilities of U.S. Army, U.S. Navy, and USMC rotary-wing

aircraft are specified in MIL-STD-1366E and provided in Appendix C. A prerequisite to flight testing is the successful accomplishment of proof load testing of the lift provisions and/or compression testing of the item in accordance with MIL-STD-913A described previously in paragraph 4.1. Prior to flight testing, inspect all lift provisions and adjacent structural components to ensure integrity. If any damage or deformation exists, the item should not be flight tested pending repair or replacement.

b. The test item shall undergo static lift testing to verify sling leg clearances and load orientation prior to flight testing. Rig the item with a standard military sling set in accordance with the draft rigging procedures provided by NSRDEC and in accordance with FM 4-20.197.[28] The sling set nomenclature and capacities are listed in Table 3. Employment of a spreader bar to avoid sling-to-item interference is discouraged due to the logistics burden and additional rigging time required. Equipment employing a spreader bar for EAT is required to stow the bar as On-Vehicle Equipment (OVE). Additionally, compressive load testing of the spreader bar, unless previously tested or type classified, will be required prior to flight testing.

TABLE 3. MILITARY EXTERNAL AIR TRANSPORT SLING SETS

Service	Sling Set Capacity		NSN	Sling Leg Load Limit		Type
	kg	lb		kg	lb	
Army	4,536	10,000	1670-01-027-2902	5,126	11,300	Rope
Army	11,340	25,000	1670-01-027-2900	10,206	22,500	Rope
Marine Corps	6,804	15,000	1670-00-902-3080	12,111	26,700	Web
Marine Corps	18,144	40,000	3940-01-183-2118	18,053	39,800	Rope
Marine Corps (V/STOL MV-22 Aircrafts)	11,340	25,000	1670-01-027-2900	10,206	22,500	Rope

Once rigged, attach the sling set apex to the cargo hook of a mobile or overhead crane and hoist the item from the ground. Note any sling-to-item contact or interference. Measure and record the angle of inclination of the load with respect to the ground. If the desired orientation identified by NSRDEC was not achieved (i.e., level, 5° nose downward), adjust the rigging until the desired orientation is attained. Record the final rigging configuration (link counts).

c. Position the test item on the test pad with its designated front facing into the prevailing wind. Engage the parking brakes on vehicles, trailers or weapon systems equipped with parking brake systems. Secure loose brake lines, intervehicular cables and safety chains of towed items with tape or nylon cord. Remove, stow, and secure all soft-top covers in a designated shelter or to the item in some fashion. Secure all external and internal equipment, and vents and access doors using tape, nylon cord, or cargo straps if a positive means of securement is not already provided. Rig the sling set in a breakaway fashion to prevent any interference during load hookup. Photograph the resultant rigging configuration.

d. Flight test the item with each military aircraft specified and for each rigging configuration desired (i.e., single and dual point rigging). The rigging crew will access the highest point of the load. Document any difficulties experienced in accessing or departing the load due to a lack of adequate footholds, handles, etc. As the helicopter hovers over the load, the static discharge wand handler contacts the wand (if required) to the cargo hook of the helicopter as the second rigger attaches the apex fitting to the cargo hook. Once the rigging crew has departed the load, the aircrew performs the flight test in accordance with the MSFDCS, provided as Appendix D. The aircraft will accomplish flight testing in a predetermined flight path/area that is predominately uninhabited. Photograph the test item slung under each aircraft to document load orientation. When available, videotape the flight test by either an on-board camera or via chase aircraft to record the flight. Following the completion of the flight test, the aircrew returns the load to the test pad. Perform visual and functional inspections of the item. Record and photograph any evidence of physical damage as a result of the flight test.

4.8.2 Data Required.

a. Record of test item condition for test (fuel and lubricant levels, missing or damaged components).

b. List of test item preparation for flight testing.

c. Configuration and tie-down diagrams for pallet loads, if applicable.

d. Sling set type and number of sling legs employed.

e. Sling set link counts, front and rear.

f. Characteristic photographs of rigged test item.

g. Angle of inclination of the load with respect to the ground during static testing.

h. Record of any difficulties experienced in accessing and departing test item by rigging crew.

i. Photographs of test item slung from each aircraft.

j. Videotape of flight test, when available.

k. Completed and signed MSFDCS, including item weight and prevailing meteorological conditions.

l. Results of post-test visual and functional inspections.

4.9 Air Transportability - Airdropped Materiel.

The objective of this test is to determine the suitability of the test item to be airdropped from fixed-wing aircraft. NSRDEC is responsible for certification of Army equipment for airdrop. NSRDEC is recognized in the DOD as the subject matter expert for cargo airdrop. And as a result, the other services request that NSRDEC support their cargo airdrop certification requirements.

4.9.1 Method.

a. Lift/Tie-down Provision Compatibility. Inspect the test item for location and compatibility of tie-down and lifting points. Employ data obtained from the lift and tie-down attachments subtest (para 4.1) when appropriate. Verify compatibility of test item points with load anchoring points on the aircraft or airdrop platform. Inspect and measure tie-down, suspension and extraction provisions to identify number, location, dimensions and clearances as required by MIL-STD-814D.

b. Provision Integrity and Aircraft Compatibility. Prepare the test item for airdrop by either the suspension or extraction method, or both, as identified by NSRDEC in accordance with TM 10-500-2[29] and MIL-STD-669B.[30] Weigh and measure overall physical characteristics of the rigged load to determine conformance with MIL-STD-814D and for compatibility with the designated carrier aircraft. Accomplish static pull tests of suspension or extraction provisions and components to verify compliance with MIL-STD-814D (para 4.1).

c. Energy Dissipation. If specific provisions for energy dissipation are not provided, subject the prepared test item to deceleration force levels less than the g +1, or 19.5 times the item airdrop weight, specified by MIL-HDBK-669, using trial force levels as recommended by the developer. Progressively increase low force levels, making observations for any indications of damage, up to the maximum ratio of g +1 or 19.5 ±10 percent. However, the energy dissipation kit should be provided by NSRDEC.

d. Simulated Airdrop Impact Test (SAIT) (Low Velocity). Assemble, secure, balance and cushion the test item on a pallet or other appropriate carrier in accordance with NSRDEC draft procedures and MIL-HDBK-669. Attach the test item to the cargo lifting hook of a static drop facility. The facility and lifting device will be high enough to permit the bottom of the cargo to be raised a minimum of 3.87 m (12.7 ft), the equivalent of 8.7 m/sec (28.5 ft/sec) free-fall, above the ground. The impact area will be level, constructed of a minimum of 0.3-m (1.0-ft) thick reinforced concrete or similar rigid material. Affix an accelerometer(s) to a centrally located hard point and/or to any sensitive items within the load. Attach the rigged item to the lifting hook of the facility and raise the item off the ground until its lower edge is positioned 3.87 m (12.7 ft) above the ground. Adjust the rigging material to achieve a level suspension attitude, as necessary. Record the vertical distance from the ground to the load. Release the cargo hook, allowing the item to free-fall to the ground. Record the accelerometer readings. Conduct visual and functional inspections of the load and record the results.

e. Airdrop. Prior to live airdrop testing, an airdrop Proposed Test Plan (PTP) must be submitted to the U.S. Air Force Aeronautical Systems Center (HQ ASC), Wright-Patterson AFB and U.S. Air Force Air Mobility Command (HQ AMC), Scott AFB. A PTP approval from HQ ASC and HQ AMC is required before live airdrop testing can be conducted from Air Force fixed wing aircraft. Rig the test item in accordance with instructions provided/approved by NSRDEC. Document any deviations or additions to the instructions. Following completion of the rigging, conduct a Joint Aircraft Inspection (JAI) to verify procedures and load worthiness. Transfer the load to the aircraft by any safe means available and acceptable to the aircrew. Document the load transfer procedure, including the identification of aircraft loader employed, when applicable. Secure the item to the aircraft in accordance with USAF instructions. Document any deviations or additions to the instructions. Following item securement, conduct a second and final JAI. Upon completion of the JAI and acceptance of the load, all responsibility for the mission is transferred to the USAF. The altitude, air speed, and drop zone for the test are identified and coordinated with the air crew, test facility, and USAF. Employ ground tracking, photography, and instrumentation to record position versus time, flight trajectory, and impact velocity and acceleration. After load impact, conduct a visual inspection of the test item, instrumentation and parachute system (airdrop only). Record and photograph any evidence of physical damage as a result of the airdrop. Upon completion of de-rigging, conduct a visual and functional inspection of the load. Record the results of the inspections.

4.9.2 Data Required.

a. Dimensional and strength measurements of tie-down, lifting and anchoring points, number, and location.

b. Rigging diagrams and procedures.

c. Weight and overall physical characteristics of rigged item.

d. Compatibility of the test item with the airdrop platform and the aircraft.

e. Static pull test results (Paragraph 4.1).

f. Energy dissipation test results.

g. Vertical distance between item and ground (ground impact test).

h. Free-fall acceleration (ground impact test).

i. Time to rig test item.

j. Photographs of the rigged configuration.

k. Position versus time data at a rate of five times per second (airdrop).

l. Impact velocity (airdrop).

m. Impact accelerations (airdrop).

n. Results of visual and functional inspections.

o. Video & High-Speed Video of SAIT.

p. Video for live airdrop.

5. DATA REQUIRED.

Data required can found throughout Section 4: Test Procedures.

6. PRESENTATION OF DATA.

6.1 Slinging and Tie-down Attachments.

Compile a list or diagram specifying the location and classification of each slinging and tie-down provision if a data plate or similar information has not been provided by the materiel developer or manufacturer. Describe the method and equipment employed to secure the item for each load application. Tabulate the results of the pull testing. Any deformation or weld cracking of the provisions or adjacent structural components is considered a failure to satisfy the Military Standard. Photographs will document the physical damage or deformation experienced.

6.2 Rail Transportability.

As listed in paragraph 5, TOP 1-2-501.

6.3 Road Transportability.

Summarize physical parameter measurements, emergency brake stopping, road testing, and recovery vehicle operation testing in tables. Describe the details of test incidents in narrative form and illustrate physical events with photographs.

6.4 Marine Transportability.

Summarize and tabulate the data to present peak or critical measurements, displacements, and interferences. Include supporting photographs, sketches and curves as appropriate. Describe the details of test incidents in narrative form and illustrate physical events with photographs.

6.5 Terminals Handling and Movement.

Review and compare measured and observed data to ensure that test objectives and system criteria were achieved. Analyze the degradation of performance from pretest levels, in the case of sheltered systems or packaged equipment, or any item damage with respect to the effect on materiel utility and provisions of the applicable criteria. Analyze shock and vibration data to determine peak values and frequency content. Describe the details of test incidents in narrative form and illustrate physical events with photographs.

6.6 Air Transportability - Fixed Wing Internal.

Analyze the measured data in accordance with MIL-HDBK-1791 to determine the suitability of the test item for transport on USAF and CRAF aircraft. If a test loading is conducted, describe the measured interferences between the test item and the aircraft. Once all possible interferences are resolved, the test item will be certified for air transport in a letter from the USAF ATTLA.

6.7 Air Transportability - Rotary Wing Internal.

Describe the actions taken to service and prepare the item for aircraft loading. Describe the method employed in loading and unloading the item into the aircraft. Photographs of the item during and upon completion of the loading will document the loading and tie-down configuration. Present in narrative form any incidents or interferences noted during the loading and unloading.

6.8 Air Transportability - Rotary Wing External.

Describe the actions taken to prepare the load for flight testing. Photographs of the test item will document the rigging configuration and sling orientation. Summarize the results of the MSFDCS in tabular or narrative form, supplemented by any observations made by a review of the flight test videotape(s). Compare the results of the flight tests to the criteria listed in MIL-STD-913A. Provide the original MSFDCS to the NSRDEC project officer for the test file. Provide a recommendation as to the maximum safe speed for EAT of each load configuration and helicopter combination. Identify any restrictions of EAT load configurations if flight test results were unsatisfactory.

6.9 Air Transportability - Airdropped Materiel.

Summarize physical parameter measurements in a table. Identify any incompatibilities between the airdrop platform and designated aircraft. Describe the actions taken to prepare and rig the load. Photographs of the test item will document the rigging configuration. Summarize the results of each test phase in tabular or narrative form, supplemented by observations made by a review of film and videotapes. Describe the results of visual inspections and functional checks accomplished following each test phase, illustrating physical events with photographs.

APPENDIX A. FIXED WING AIR TRANSPORTABILITY REQUIREMENTS

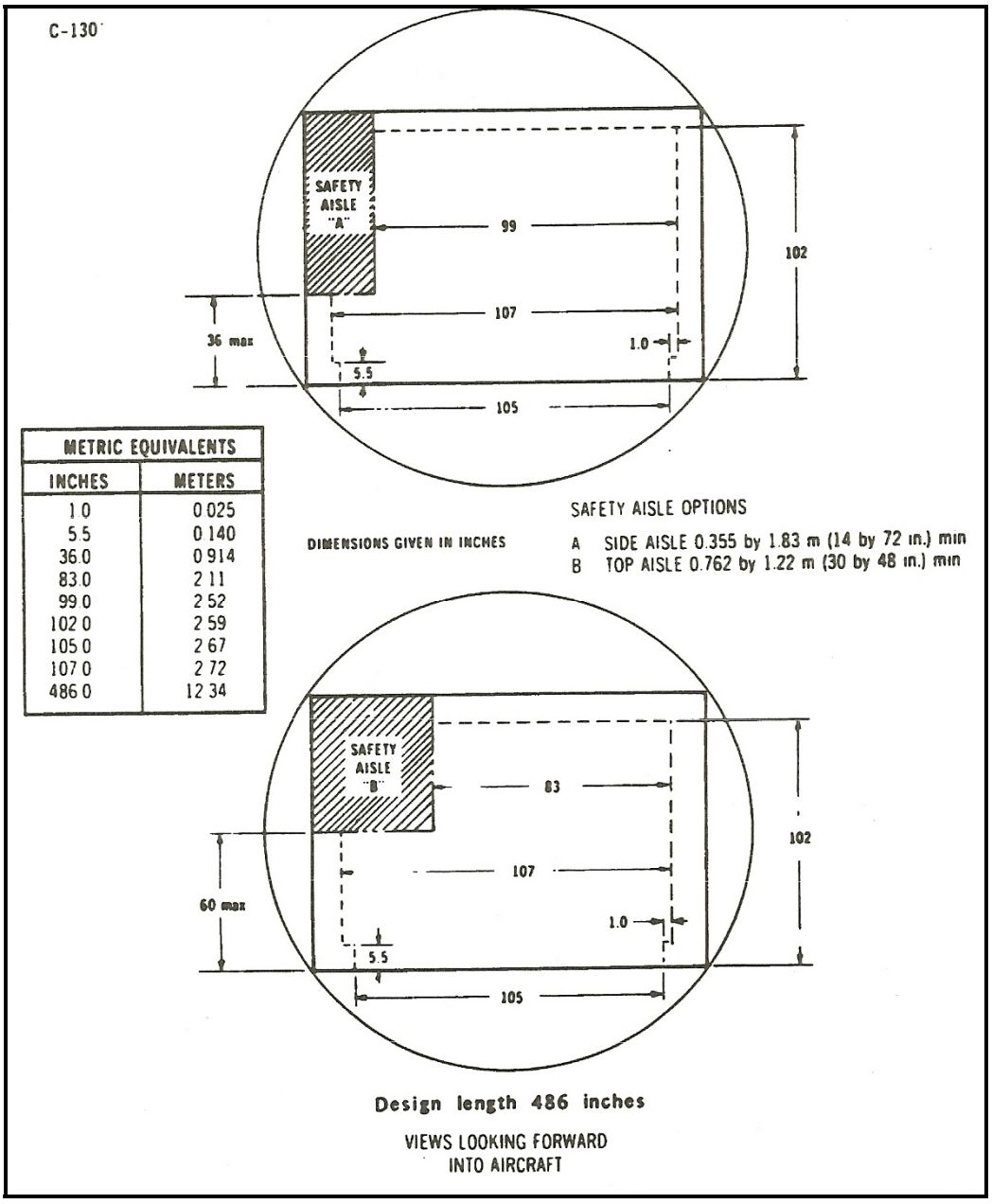
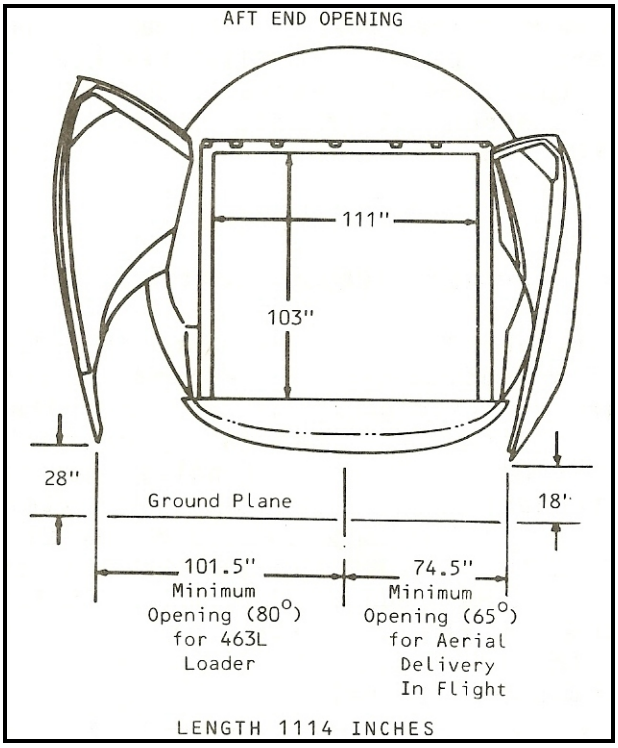


Figure A-1. C-130 cargo dimensional limits.

Note: For vehicle with tracks and non-sensitive steering, 6-in. of rolling shoring is required when the clearance between the side rails and the vehicle is critical. Vehicles with clearance of less than 2-1/2-inches on each side require ATTLA review and approval. These data are derived from MIL-HDBK-1791.



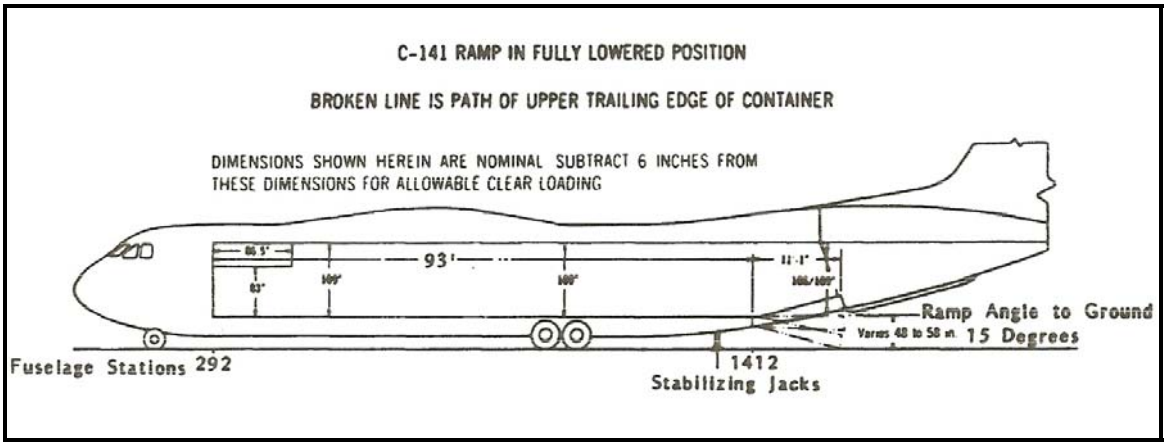


Figure A-2. C-141 cargo dimensional design limits

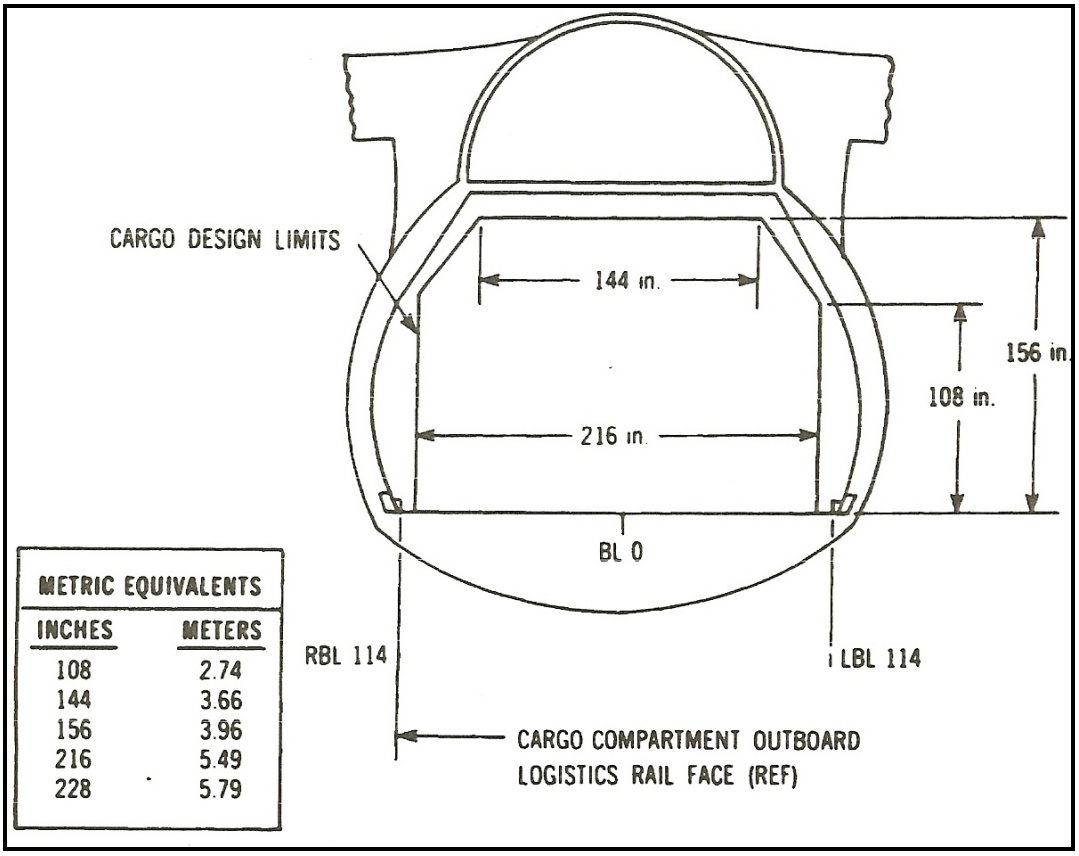
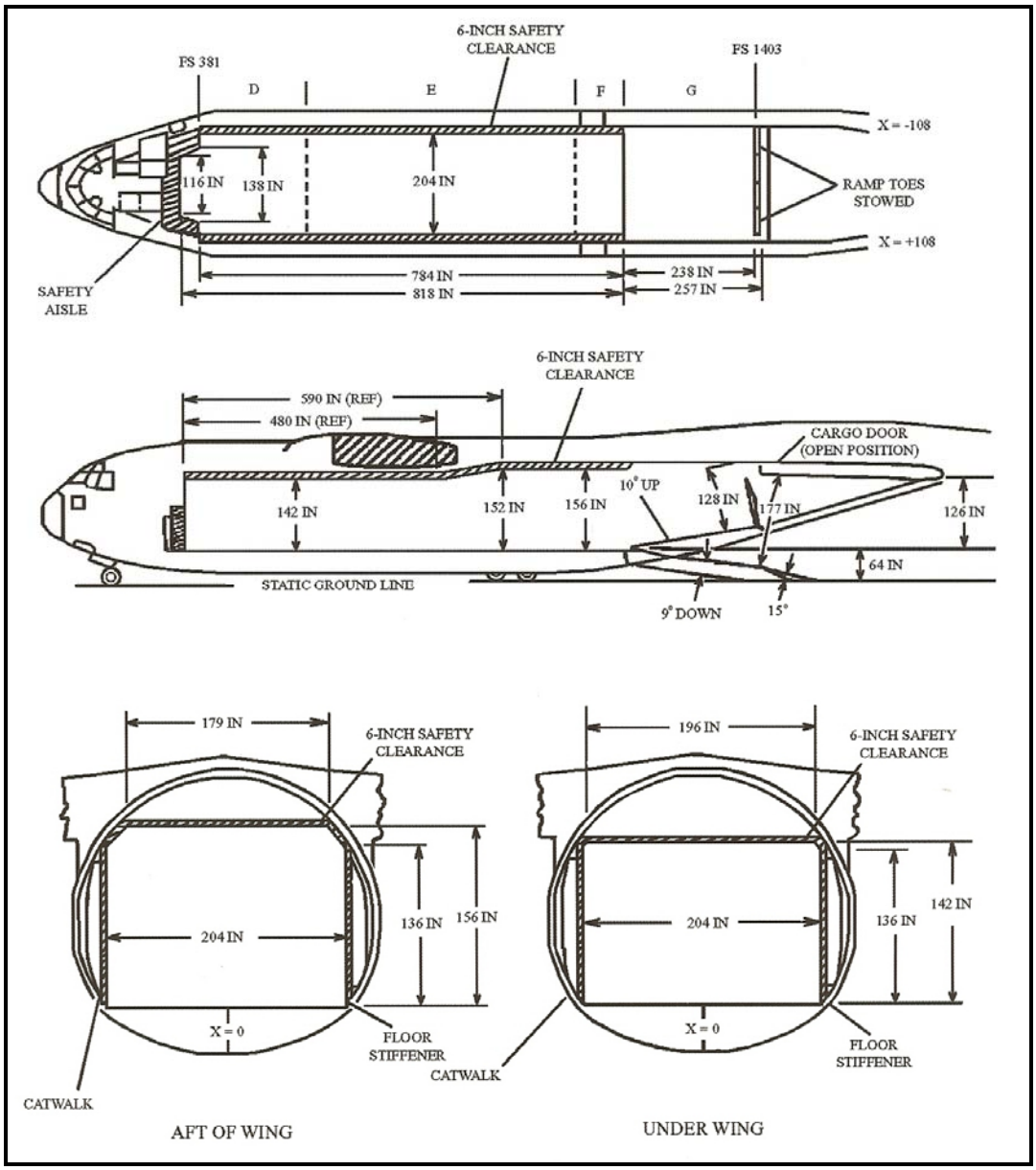


Figure A-3. C-5A/B cargo dimensional limits.

Notes: Cargo dimensional design limits shown above are the maximum deployable dimensions to be used in the design of cargo items to be transported in the C-5°/B. Design length is 121 ft and 2 in. These data are derived from MIL-HDBK-1791



Figures A-4. C-17 cargo dimensional design limits.

TABLE A-1. FIXED WING AIRCRAFT CARGO CAPABILITY

	EFFECTIVE ACL[a]		MAXIMUM ACL[b]	
AIRCRAFT	kg	lb	kg	lb
C-130	6,800	15,000	19,050	42,000
C-141	27,220	60,000	48,830	90,000
C-5	80,740	178,000	120,200	265,000
C-17	58,970	130,000	77,110	170,000

[a] Effective allowable cabin load (ACL) is defined as the longest leg over a water route. The range and mission payload capability of the aircraft varies depending on crew, fuel and oils on board, temperature, and winds. The weight and balance (center of gravity) of the aircraft is vitally important to its stability.

[b]Maximum ACL is a contingency capability which is defined as a short-range or war-time mission. Designers should use the values for the effective ACL.

APPENDIX B. ROTARY-WING AIRCRAFT INTERNAL PAYLOAD CAPABILITIES

TABLE B-1. MAXIMUM HELICOPTER INTERNAL LOAD

MISSION SCENARIO	CH-46E	CH-47D	CH-53D	CH-53E	MV-22
	lb	lb	lb	lb	lb
Sea Level, 60F, 30 nautical mi	6,000	23,300	14,770	34,990	13,850
2,000 ft, 70F, 30 nautical mi	5,600	23,350	13,970	28,600	9,840
4,000 ft, 95F, 30 nautical mi	3,890	16,900	7,910	18,600	8,010

TABLE B-2. HELICOPTER INTERNAL TRANSPORT CONSTRAINTS[a]

HELICOPTER	HEIGHT	WIDTH	LENGTH
	in.	in.	in.
CH-46	69	72	290
CH-47D	72	80	331
CH-53E	77	90	450
MV-22	60	66	250

[a]These design limits allow for a 6-in. safety clearance between the equipment and the aircraft overhead and a 5-in. clearance between the equipment and the aircraft sidewalls.

TABLE B-3. CONSTRAINTS FOR NAVY MARINE CORPS ROTARY-WING AIRCRAFT

AIRCRAFT	CARGO OPENING DIMENSIONS[a]			CARGO COMPARTMENT				CRASH LOAD RESTRAINT CRITERIA				
	LOCATION	WIDTH, in.	HEIGHT, in.	LENGTH, in.	WIDTH, in.	HEIGHT (AT FLOOR LINE), in.	STRUCTURAL[b] FLOOR LOAD LIMITS, lb/ft^2	FORWARD G's	AFT G's	LATERAL G's	UP G's	DOWN G's
SH-3G	Side	68	60	231	76	71	300	8	4	4	4	4
H-46A/D/E	Rear ramp	70	69	290	72	69	300	10	7.5	3	3	10
SH-608	Side	44	54	130	73	54	225	8	4	4	4	8
SH-60F	Side	44	54	130	73	54	75 Fwd cabin 300 Aft cabin	8	4	4	4	8
HH-60H	Rear ramp	44	54	130	73	54	75 Fwd cabin 300 Aft cabin	8	4	4	4	8
CH-53A	Rear ramp	96	77	450	90	77	300	10	7.5	3	3	10
CH-53D	Rear ramp	96	77	450	90	77	300	10	7.5	3	3	10
RH-53D	Rear ramp	96	77	450	90	77	300	10	7.5	3	3	10
CH-53E	Rear ramp	96	77	450	90	77[c]	300	10	7.5	3	3	10
MH-53E	Rear ramp	96	77	450	90	77[d]	300	10	7.5	3	3	10
V-22	Rear ramp	72	90	290	71	68	300	16	5	10	5	16

[a]Dimensional limits given are airframe dimensions. Clearances must be provided as follows: 6 in. at the top, 10 in. (minimum) on one side for personnel passageway, and 5 in. on the other side.

[b]Structural flower load limits for entire cargo compartment. For wheeled vehicle, conveyor, etc. load limits, see respective cargo, loading manual, Naval Air Training and Operating Procedures Standardization Program (NATOPS) Flight Manual, Aircraft Weight and Balance Manual for each aircraft.

[c]73 in. when single point cargo hook is stowed and 75 in. unstowed.

[d]58. in. aft cabin when Mine Counter Measure (MCM) equipment is installed.

Note: This table was derived from MIL-STD-1366E.

TABLE B-4. CONSTRAINTS FOR ARMY ROTARY-WING AIRCRAFT

AIRCRAFT	CARGO OPENING DIMENSIONS[a]			CARGO COMPARTMENT[c]				CRASH LOAD RESTRAINT CRITERIA				
	LOCATION	WIDTH, in.	HEIGHT, in.	LENGTH, in.	WIDTH, in.	HEIGHT, in.	STRUCTURAL FLOOR LOAD LIMITS, lb/ft^2	FORWARD G's	AFT G's	LATERAL G's	UP G's	DOWN G's
UH-1H	Each side	92/74[b]	49	82/47.5[d]	77/15[d]	46	100	8	8	8	4	8
UH-60 (A/L/K)	Each side	68	52	92/127.5[e]	50/46[e]	46	300	12	3	8	3	
CH-47 (C/D/E)	Rear ramp	90	78	331	80	72	300 (or 2500 on treadway)	4	2	1.5	2	4

[a]Dimensions given are airframe dimensions. Additional clearance of 6 in. between the equipment and the aircraft ceiling must be provided.

[b]Dimensions are for both doors and sliding door opened respectively.

[c]Dimensions allow a 5 in. clearance inside the centerline of the perimeter tie-down fittings and clearance of 6 in. between the equipment and the aircraft ceiling.

[d]The first length and width dimensions are for the total cargo compartment. However, they do not allow for transmission box. The second length dimension is the unobstructed allowable cargo length form front of cargo compartment to transmission box. The second width dimension is the allowable cargo width for the areas on either side of the transmission box.

[e]Second dimension includes gunner's area.

APPENDIX C. ROTARY-WING AIRCRAFT EXTERNAL PAYLOAD CAPABILITIES

TABLE C-1. MAXIMUM HELICOPTER EXTERNAL LOAD

MISSION SCENARIO	UH-1H	UH-60A	UH-60L	CH-46E	CH-47D	CH-53D	CH-53E	MV-22[a]
	lb	lb	lb	lb	lb	lb	lb	lb
Sea Level, 60F, 30 nautical mi	2,585	7,843	9,000	5,915	23,324	14,700	34,770	13,320
2,000 ft, 70F, 30 nautical mi	2,624	7,302	9,000	5,480	23,396	13,900	28,300	9,330
4,000 ft, 95F, 30 nautical mi	1,169	4,700	6,630	3,780	16,644	7,860	18,200	7,500

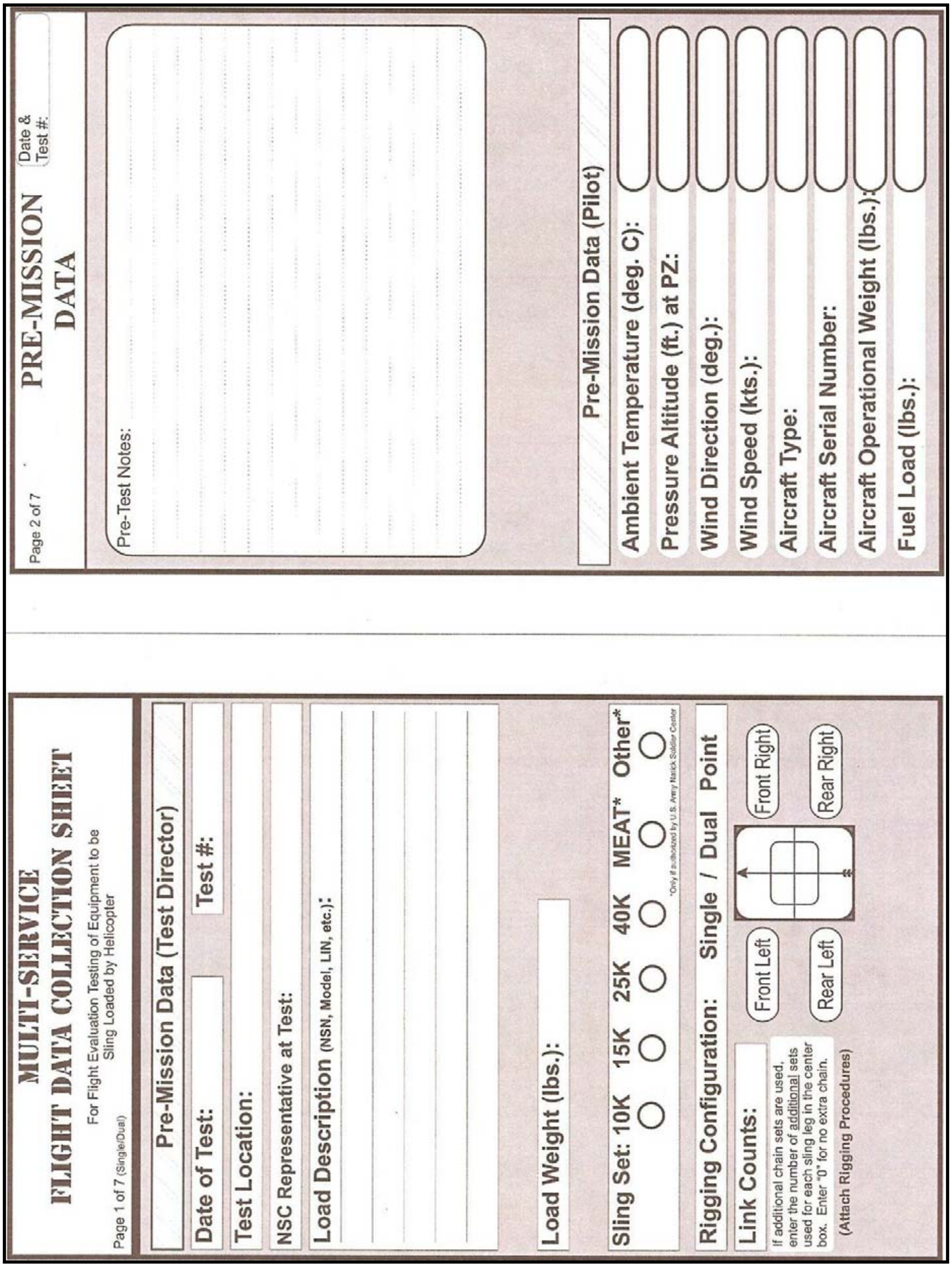
[a]The Marine V-22 helicopter is under-development.

TABLE C-2. HELICOPTER CARGO HOOK LOAD RATINGS[a]

HELICOPTER	HOOK(S) LOAD RATINGS
UH-1H	4,000 lb
UH-60A/L	9,000 lb
CH-46E	10,000 lb
CH-47D	26,000 lb center hook/17,000 lb fore and aft hooks
CH-53E	36,000 lb
MV-22	15,000 lb single hook/10,000 lb dual hook

[a]Although the primary limitation to EAT is the available payload (Table C-1), an additional limitation is the helicopter hook strength.

APPENDIX D. EXTERNAL AIR TRANSPORTABILITY MULTI-SERVICE FLIGHT DATA COLLECTION SHEET (MSFDCS) AND RATING CRITERIA



MULTI-SERVICE FLIGHT DATA COLLECTION SHEET

For Flight Evaluation Testing of Equipment to be Sling Loaded by Helicopter

Page 1 of 7 (Single/Dual)

Pre-Mission Data (Test Director)

Date of Test:

Test #:

Test Location:

NSC Representative at Test:

Load Description (NSN, Model, LIN, etc.):

Load Weight (lbs.):

Sling Set: 10K ○ 15K ○ 25K ○ 40K ○ MEAT* ○ Other* ○

*Only if authorized by U.S. Army Natick Soldier Center

Rigging Configuration: Single / Dual Point

Link Counts:

Front Left | Front Right

Rear Left | Rear Right

If additional chain sets are used, enter the number of additional sets used for each sling leg in the center box. Enter "0" for no extra chain.

(Attach Rigging Procedures)

Page 2 of 7

PRE-MISSION DATA

Date & Test #:

Pre-Test Notes:

Pre-Mission Data (Pilot)

Ambient Temperature (deg. C):

Pressure Altitude (ft.) at PZ:

Wind Direction (deg.):

Wind Speed (kts.):

Aircraft Type:

Aircraft Serial Number:

Aircraft Operational Weight (lbs.):

Fuel Load (lbs.):

Page 3 of 7

SECTION I

Date & Test #:

HOVER & TRANSITIONAL

MANEUVERS	Response Rating (See page 7 for criteria.) Better ←→ Worse A B C D F
Hover in Ground Effect (HIGE)	A B C D F
Left Turn on Spot, HIGE	A B C D F
Right Turn on Spot, HIGE	A B C D F
Left Slide, 10 deg. AOB, HIGE	A B C D F
Right Slide, 10 deg. AOB, HIGE	A B C D F
Hover Out of Ground Effect (HOGE)	A B C D F
Left Turn on Spot, HOGE	A B C D F
Right Turn on Spot, HOGE	A B C D F
Left Slide, 10 deg. AOB, HOGE	A B C D F
Right Slide, 10 deg. AOB, HOGE	A B C D F
Transition to Forward Flight	A B C D F
Transition from Forward Flight	A B C D F

Page 4 of 7

SECTION II

Date & Test #:

STRAIGHT & LEVEL FLIGHT

AIRSPEED	Do Slings Go Slack?	Is There Sling Interference?	Response Rating (See page 7 for criteria.) Better ←→ Worse A B C D F
(KIAS)	Yes No	Yes No	A B C D F
(KIAS)	Yes No	Yes No	A B C D F
(KIAS)	Yes No	Yes No	A B C D F
(KIAS)	Yes No	Yes No	A B C D F
(KIAS)	Yes No	Yes No	A B C D F
(KIAS)	Yes No	Yes No	A B C D F
(KIAS)	Yes No	Yes No	A B C D F
(KIAS)	Yes No	Yes No	A B C D F
(KIAS)	Yes No	Yes No	A B C D F

Reason(s) for stopping at the highest airspeed:

- ○ A/C Limitations
- ○ Load Instability
- ○ Excessive Fleet Angle
- ○ Other (explain on reverse side)

SECTION III

Date & Test #:

CLIMBING/DESCENDING & TURNING

All Maneuvers Listed Below Performed at: (KIAS)

Max. Authorized Angle of Bank (AOB max.):

Max. Authorized Rate of Descent (FPM):

Note: The maneuver AOB's and rates given below are recommended. DO NOT EXCEED OPERATIONAL LIMITATIONS

Aircraft Gross Weight: (lbs.)

Response Rating (See page 7 for criteria.)

Better ⟵⟶ Worse

MANEUVERS	A	B	C	D	F
STRAIGHT CLIMB, minimum 500 FPM	A	B	C	D	F
STRAIGHT DESCENT, minimum 500 FPM	A	B	C	D	F
PULL OUT, STANDARD RATE	A	B	C	D	F
SMALL CONTROL REVERSALS (All 3 Axes)	A	B	C	D	F
COORDINATED LEVEL RIGHT TURN, 15 deg. AOB	A	B	C	D	F
COORDINATED LEVEL RIGHT TURN, 30 deg. AOB	A	B	C	D	F
COORDINATED LEVEL RIGHT TURN, AOB max.	A	B	C	D	F
CLIMBING RIGHT TURN, 30 deg. AOB, minimum 500 FPM	A	B	C	D	F
CLIMBING RIGHT TURN, AOB max., Minimum 500 FPM	A	B	C	D	F
DESCENDING RIGHT TURN, 30 deg. AOB, min. 500 FPM	A	B	C	D	F
DESCENDING RIGHT TURN, AOB max., Minimum 500 FPM	A	B	C	D	F
PULL OUT, STANDARD RATE	A	B	C	D	F
COORDINATED LEVEL LEFT TURN, 15 deg. AOB	A	B	C	D	F
COORDINATED LEVEL LEFT TURN, 30 deg. AOB	A	B	C	D	F
COORDINATED LEVEL LEFT TURN, AOB max.	A	B	C	D	F
CLIMBING LEFT TURN, 30 deg. AOB, minimum 500 FPM	A	B	C	D	F
CLIMBING LEFT TURN, AOB max., Minimum 500 FPM	A	B	C	D	F
DESCENDING LEFT TURN, 30 deg. AOB, min. 500 FPM	A	B	C	D	F
DESCENDING LEFT TURN, AOB max., Minimum 500 FPM	A	B	C	D	F
PULL OUT, STANDARD RATE	A	B	C	D	F

Maximum Attained AOB: (Deg.)

Maximum Attained Rate of Descent: (FPM)

Were the climbing/descending maneuvers conducted at a minimum rate of 500 FPM?
(If no, explain in comments section on page 6.) Yes No

SECTION IV

Date & Test #:

OVERALL PERFORMANCE

Maximum Recommended Straight and Level Airspeed for HSL Certification: (Knots)

Response Rating (See page 7 for criteria.)

Better ⟵⟶ Worse

A B C D F

	A	B	C	D	F
Flight Characteristics of Aircraft	A	B	C	D	F
Flight Characteristics of Load	A	B	C	D	F

Were there any problems with hook-up or drop-off of the load?
(If Yes, comment in Comments section.) Yes No

Did the load cause any interference with the radar altimeter? Yes No

Comments:

Pilot Name (print):

Telephone: ( ) DSN

Signature:

Page 7 of 7

RATING CRITERIA FOR AIRCRAFT FLIGHT CHARACTERISTICS WITH EXTERNAL LOADS

A. Excellent handling qualities. Effects of the load upon the aircraft performance are negligible at the prescribed airspeed.

B. Good handling qualities. Effects of the load on the aircraft performance are noticeable, but require little or no effort from the pilot to maintain control of the aircraft at the prescribed airspeed.

C. Fair handling qualities. Effects of the load on the aircraft performance are moderate, but readily controllable. The pilot should exercise moderate caution and pay close attention to the effects of the load on the aircraft in order to maintain control of the aircraft at the prescribed airspeed.

D. Poor handling qualities. Effects of the load on the aircraft performance are significant and require constant attention from the pilot to control the aircraft. Caution must be maintained at all times in order to control the aircraft at the prescribed airspeed.

F. Unacceptable handling qualities. Flight under these conditions is dangerous and requires constant attention from the pilot to avoid loss of control of the aircraft. Aircraft is constantly unstable. Flight at this or higher air speed is not recommended.

RATING CRITERIA FOR EXTERNAL LOAD STABILITY CHARACTERISTICS DURING FLIGHT

A. Excellent Load Stability: Load maintains directional stability throughout maneuvers. Minimal load oscillation and/or minimal load rotation or weathervaning. Requires minimal concentration by the flight crew.

B. Good Load Stability: Load maintains directional stability for most maneuvers. Only moderate load oscillation and/or moderate load rotation or weathervaning occurs. Requires minimal concentration by the flight crew.

C. Fair Load Stability: Load may oscillate, rotate and/or weathervane during most maneuvers. Directional orientation is not stable throughout maneuvers. However the load remains stable in its rotational state, the rotation does not continue to wind up the sling legs, and the load does not pose a threat to the aircraft.

D. Poor Load Stability: Load oscillates, rotates, or weathervanes during all maneuvers. Directional instability may become severe and require immediate action by the flight crew to prevent damage to the load and/or aircraft, or danger to personnel.

F. Unacceptable Load Stability: Load is uncontrollable for most or all of the maneuvers. Directional instability is unpredictable and dangerous. Transport of the load at the prescribed airspeed is not recommended.

MULTI-SERVICE
FLIGHT DATA COLLECTION SHEET

For Flight Evaluation Testing of Equipment to be Sling Loaded by Helicopter

Page 1 of 7 (Tandem/Shotgun)

Pre-Mission Data (Test Director)

Date of Test: **Test #:**

Test Location:

NSC Representative at Test:

Load Description (NSN, Model, LIN, etc.):

Load Wt. (lbs.) 1): Total:
2):

Sling Set: 10K (1 2) 15K (1 2) 25K (1 2) 40K (1 2) MEAT* (1 2) Other* (1 2)

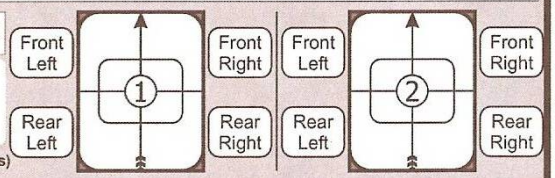
*Only if authorized by U.S. Army Natick Soldier Center

Rigging Configuration: Tandem / Shotgun

Link Counts:

If additional chain sets are used, enter the number of additional sets used for each sling leg in the center box. Enter "0" for no extra chain.

(Attach Rigging Procedures)



TANDEM / SHOTGUN LOAD CONFIGURATION

1. When conducting flight evaluation testing of Tandem or Shotgun Loads, replace Page 1 of 7 (Single/Dual) of the Multi-Service Flight Data Collection Sheet (MSFDCS), with Page 1 of 7 (Tandem/Shotgun).

2. For Tandem Loads, Load #1 is the forward load, and Load #2 is the aft load, relative to the aircraft. For Shotgun Loads, Load #1 is the left load and Load #2 is the right load.

APPENDIX E. ACRONYMS

ACC	= Air Combat Command
AFB	= Air Force Base
AFSOC	= Air Force Special Operations Command
AMC	= Air Mobility Command
ANSI	= American National Standards Institute
ASFS	= Army Standard Family of Shelters
ASTM	= American Society of Testing and Materials
ATTLA	= Air Force Air Transportability Test Loading Agency
BII	= basic issue items
CONUS	= Continental United States
CRAF	= Civil Reserve Air Fleet
DOD	= Department of Defense
EA	= Executive Agent
EAT	= external air transport
AGL	= above ground level
FMVSS	= Federal Motor Vehicle Safe Standard
GAWR	= gross axle weight rating
GCWR	= gross cargo weight restriction
GSW	= gross shipping weight
GVWR	= gross vehicle weight restriction
GWR	= gross weight restriction
HSL	= helicopter sling load
IAT	= internal air transport
ISO	= International Standards Organization
ITOP	= International Test Operations Procedures
JAI	= Joint Aircraft Inspection
LAPE	= Low Altitude Parachute Extraction
LASH	= Lighter Aboard Ship
LOLO	= lift on/lift off
LOTS	= Logistics-Over-the-Shore
MCM	= Mine Counter Measure
MHE	= materiel handling equipment
MSFDCS	= Multi-Service Flight Data Collection Sheet
NATO	= North Atlantic Treaty Organization
NATOPS	= Naval Air Training and Operating Procedures Standardization Program
NAVAIR	= Naval Air Systems Command
NSRDEC	= Natick Soldier Research, Development, and Engineering Center
OMS/MP	= Operational Mode Summary/Mission Profile
OVE	= On-Vehicle Equipment
PM	= Product Manager
POL	= petroleum, oils, and lubricants
PTP	= Proposed Test Plan
RORO	= roll on/roll off
SAIT	= Simulated Airdrop Impact Test

SDDCTEA	= Surface Deployment and Distribution Command – Transportation Engineering Agency
SEABEE	= Sea Barge
SOP	= Standing Operating Procedure
TOP	= Test Operations Procedures
USAF	= U.S. Air Force
USAFAMC	= U.S. Air Force Air Mobility Command
USAFASC	= U.S. Air Force Aeronautical Systems Center
USANRDEC	= U.S. Army Nuclear and Chemical Agency
USMC	= U.S. Marine Corps

APPENDIX F. REFERENCES

Note: The references listed herein were the most recent revision prior to publishing this TOP. It is recommended that the most recent revision of the documents identified herein be employed unless superseded by test item requirement documents.

1. DOD Directive 4540.07, Operation of the DOD Engineering for Transportability and Deployment Program, 11 September 2007.

2. MIL-STD-1366E, Interface Standard Transportability Criteria, 31 October 2006.

3. ISO Standard 1496/1, Freight Containers – Specifications and Testing, 15 August 1990.

4. TOP 1-2-501, Rail Impact Testing, 30 June 1995.

5. RR-C-271D, Federal Specification, Chains and Attachments, Weld and Weldless, 25 September 1990.

6. MIL-STD-209K, Interface Standard for Lifting and Tiedown Provisions, 22 February 2005.

7. National Highway Traffic Safety Administration (NHTSA), Department of Transportation (DOT), Chapter 49 Code of Federal Regulation (CFR), Chapter V, Section 571.3 Definitions, October 2003.

8. MIL-STD-913A, Requirements for the Certification of Sling Loaded Military Equipment for External Transportation by Department of Defense Helicopters, 3 February 1997.

9. MIL-STD-814D, Requirements for Tiedown, Suspension, and Extraction Provisions on Military Materiel for Airdrop, 3 February 1997.

10. MIL-DTL-25959F – Detail Specification of Tie Down, Tensioners, Cargo, Aircraft, 19 January 2007

11. TEA Pamphlet 55-20, Tiedown Handbook for Truck Movements, July 2001.

12. Limits of Motor Vehicle Sizes and Weights, International Road Federation, 1989.

13. FR/GE/UK/US ITOP 2-2-609(1), Tracked Vehicle Steering, 18 May 1987.

14. TOP 1-1-011, Vehicle Test Facilities at Aberdeen Proving Ground, 6 July 1981.

15. FR/GE/UK/US ITOP 2-2-808(1), Tracked Vehicle Mechanical Vibration, 15 May 1987.

16. FR/GE/UK/US ITOP 1-2-601, Laboratory Vibration Schedules, 23 April 1998.

17. TOP 2-2-520, Logistics-Over-the-Shore (LOTS), 30 July 1970.

18. TEA Pamphlet 55-22, Lift Handbook for Marine Movement, August 2005.

19. ASTM E1925, Engineering and Design Criteria for Rigid Wall Relocatable Structures, 10 December 1997 (Obtained copies from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshocken, PA 19428, (610) 832-9585, www.astm.org.)

20. ASTM-D6055-96, Standard Test Methods for Mechanical Handling of Unitized Loads and Large Shipping Cases and Crates, May 2007.

21. ASTM-D6179-07, Standard Test Methods for Mechanical Handling of Unitized Loads and Large Shipping Cases and Crates, April 2007.

22. FR/GE/UK/US ITOP 4-2-601, Drop Tests for Munitions, 8 May 1997.

23. MIL-STD-810F, Environmental Test Methods and Engineering Guidelines, January 2000.

24. FR/GE/UK/US ITOP 4-2-602, Rough Handling Tests, 27 September 2004.

25. TOP 2-2-537, Cargo Loading Adaptability, 15 April 1971.

26. MIL-HDBK-1791 (USAF), Designing for Internal Aerial Delivery in Fixed-Wing Aircraft, 14 February 1997

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